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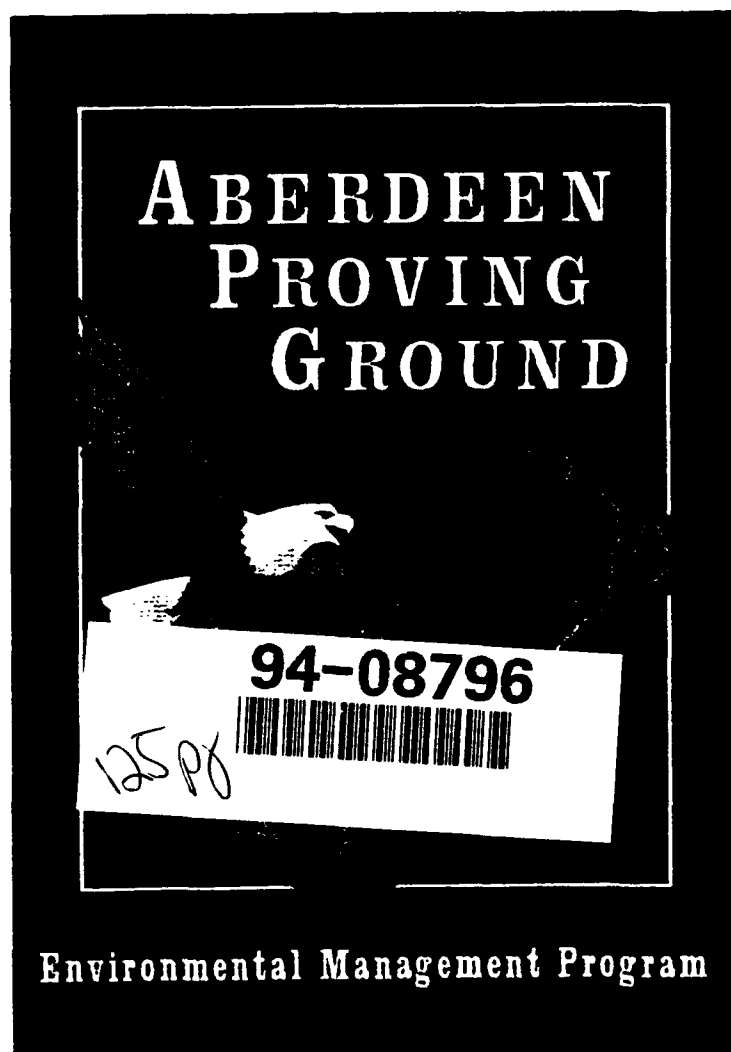
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**Beach Point Test Site
Aberdeen Proving Ground - Edgewood Area, Maryland**

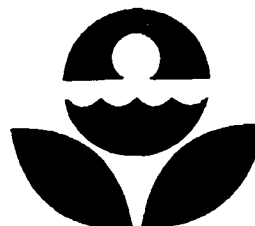
FOCUSED FEASIBILITY STUDY FINAL QUALITY ASSURANCE PROGRAM PLAN



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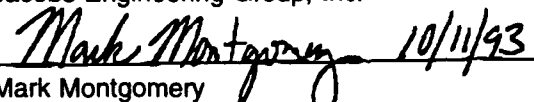
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QUALITY ASSURANCE PROJECT PLAN
U.S. ARMY ABERDEEN PROVING GROUND, EDGEWOOD AREA
BEACH POINT FOCUSED FEASIBILITY STUDY

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DEVIATIONS FROM "TERA" QAPP

JEG QAPP PAGE NUMBER	SECTION FROM "TERA" QAPP	RATIONALE
1-1	1.0 Introduction	Specific to project.
2-1	2.1 Sampling and Analysis Objectives	Specific to project
2-2	2.3 Background (Tables 2-1 thru 2-7)	Specific to project
3-2	3.1 Responsibilities	Details JEG responsibilities to EMO and JEG organization.
3-3	3.1.3 Laboratory Activities	Lab has not yet been identified and there is no USAEC auditing function, data review will be conducted by JEG.
4-4	4.2 Data Quality Objectives (Table 4-1)	Specific to project
4-9	Table 4-2, 4-3	Detailed listing of levels of concern for groundwater and surface water media.
5-1	5.1 Sample Labeling	Changed section head to Sample Numbering and Sample Labeling. Added Section 5.1.1 on sample numbering.
5-4	5.2 Containers	Variation due to use of certified clean sample containers.
5-7	5.4.1 Quality Control Samples Collected in the Field.	Added weekly blank for organic-free deionized water and filter blank. Added sentence on soil gas field QC samples. Specific to Project.
5-9	5.5 Sample Custody	Greater detail added. Cooler receipt form added. COC form will be added upon selection of lab and will be based on use of bar coding software.
5-12	5.6 Field Equipment Calibration	Substitute equipment has been specified based on EPA changes in SOPs and equipment preference based on experience. Soil gas field equipment calibration added.



DEVIATIONS FROM "TERA" QAPP (Continued)

JEG QAPP PAGE NUMBER	SECTION FROM "TERA" QAPP	RATIONALE
6-1	Section 6	Variations due to differences in projects (this project has no bioassays).
6-1	6.1.1 Sample Container Cleaning	Expanded due to use of certified clean containers.
6-1	6.1.2 Shipping Containers and Custody Seals	Detail added.
6-5	Table 6.1 - 6.6	Table 6-1 through 6-6 format change reflects expansion of information included.
6-15	6.6.1.2 Organic Chemical Analysis	Reference changed to reflect updated CLP SOW.
6-20	6.6.3 Soil Gas Chemical Analyses	Specific to project.
n/a	6.6.5 Air Monitoring Analytical Methods	Deleted. Air monitoring will not be conducted.
6-38	6.8.4 Reporting	The client may request use of another database for data management before entry of results into IRDMIS.
8-2	8.2 Internal Laboratory Quality Control Samples	Paragraph on passive soil gas sampling has been removed as none is planned at the present time.
9-2	9.1.1 Field Equipment Calibration	Specific to Project
10-1	10.1 Sampling	Deleted reference to field parameter forms bound into permanent log books as parameters will be directly recorded into log books. (Groundwater parameter measurements include pH, temperature, conductivity, dissolved oxygen, oxidation reduction potential, and turbidity. This change is reflected in the WES SOPs.)



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DEVIATIONS FROM "TERA" QAPP (Continued)

JEG QAPP PAGE NUMBER	SECTION FROM "TERA" QAPP	RATIONALE
11-1	11.0 Audits	Project specific. Field system audits reflect parameter measurements required in WES SOPs.
12-2	12.0 Corrective Action	Added signature lines for responsible persons to Corrective Action Report Form.

* All text which deviates from "TERA" QAPP is shaded to differentiate it. The "TERA" QAPP is an updated and AEHA approved version of the "O"-Field QAPP.

NOTE: Where applicable, sections of the TERA QAPP were used in this document. The TERA QAPP is an approved updated version of the "O"-Field QAPP.

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1.0 INTRODUCTION

Beach Point Test Site, APG-EA, Maryland

Focused Feasibility Study

Jacobs Engineering Group Inc. (JEG) has been contracted by Environmental Management Operations (EMO)¹ to develop a Focused Feasibility Study (FFS) for Beach Point in the Edgewood Area of Aberdeen Proving Ground (APG-EA). The task will be performed under the provisions of Master Agreement 071914-A-D7, Task Order 142133, Supplement Number 8, Task 3.

The project has been separated into work phases to allow for data evaluation between some of the field tasks. Phase I of the project consists of an aerial photography investigation, surface geophysical surveys, a flowmeter logging program, sampling surface and subsurface soils, a risk assessment of the Beach Point Test Site, and analysis of chemical groundwater data, generated through the separate Canal Creek Groundwater Monitoring Program (which includes the Beach Point Test Site).

The University of Maryland and Argonne National Laboratory are conducting additional studies at the Beach Point Test Site. Quality assurance for those studies, including applicable Standard Operating Procedures (SOPs), is the responsibility of the respective project staff, is not included in this Quality Assurance Project Plan, and will be supplied under separate cover.

The Quality Assurance Project Plan (QAPP) delineates the purpose, policies, Standard Operation Procedures (SOPs), and organization of the Quality Assurance (QA) Program which will be used to establish the integrity of APG project activities. The QAPP is divided into fourteen sections. Project description, organization, and responsibilities are delineated in Sections 1, 2, and 3. Responsibilities for field and laboratory activities are provided as well as a list of key individuals. Section 4 defines the data quality objectives for AP. Sampling protocols are delineated in Sections 5 and 6, including sample custody, collection, management, laboratory preparation, analytical procedures, and data management. Section 7 describes data management in the U.S. Army Installation

¹ EMO is operated for the U.S. Department of Energy by Battelle Memorial Institute.



Beach Point Test Site, APG-EA, Maryland

Focused Feasibility Study

Restoration Data Management Information System computer data base. System controls are listed in Section 8 for laboratory data quality, and Section 9 for equipment calibration and maintenance. Sampling and laboratory recordkeeping are delineated in Section 10. Additional quality control measures are defined in Section 11-13, and include internal and external auditing, corrective action, and quality control reports. Section 1'4 contains a bibliography of references which were used in the development of this document.

1.1 PURPOSE

Quality Assurance (QA) is defined as the overall system of activities for assuring the reliability of data produced from the sampling program. A Quality Assurance Project Plan (QAPP) covers all environmental measurements, and includes the measurement of chemical parameters in soils, sediments, and groundwater associated with the Beach Point Test Site of APG-EA. The QA system integrates the quality planning, assessment, and improvement efforts of various groups in the organization to provide the independent QA program necessary to establish and maintain an effective system for environmental analyses and related activities. The sampling program encompasses the generation of valid and complete data and its subsequent review, validation and documentation.

1.2 SCOPE

This QAPP establishes function-specific responsibilities and authorities for data quality. It defines procedures which ensure that field and laboratory activities will generate quality data. Implementation of the QA program will ensure the validity of data collected during field and laboratory operations, and establishes sound premises for decisionmaking.

Inherent in the QA program is the implementation of Quality Control (QC) measures. These measures assure that quality-related events are monitored and that data gathered in support of the FFS are accurate, precise, representative of the sample matrices, and complete.



2.0 PROJECT SCOPE

Beach Point Test Site, APG-EA, Maryland

Focused Feasibility Study

The scope of this task is to conduct an FFS for Beach Point in the Edgewood Area of Aberdeen Proving Ground, Maryland.

2.1 SAMPLING AND ANALYSIS OBJECTIVES

The sampling activities planned for this FFS are designed to evaluate potential sources of groundwater contamination in the Beach Point Test Site and define the morphology of the surficial aquifer. The activities will confirm or modify the suspected contaminants of concern in the groundwater underlying Beach Point. In addition, this task may define the lateral extent of the dense nonaqueous phase liquid (DNAPL) plume above the aquitard and better define groundwater movement patterns, depending on determination of risk.

The short-term groundwater monitoring program planned for inclusion in this task will be used to help determine treatability options. One option that will be considered is the no treatment option.

Sampling will be conducted in accordance with current U.S. Environmental Protection Agency (EPA) guidance and the subcontract laboratory will use Contract Laboratory Program (CLP) methods, where available, to ensure data of Level IV quality. Specific sampling and analysis objectives are as follows:

- To conduct groundwater analysis in order to identify the contaminants of concern and perform a biotoxicity study. The results of the groundwater sampling under this task will be used to evaluate contaminant migration, changes in contaminant concentrations, and appearance of new or disappearance of previously identified contaminants when compared with October 1989 data. The new data will be used to identify the analytical parameters for future groundwater sampling activities conducted under this task.
- To collect surface and subsurface soil samples and sediment samples for chemical analysis. The data will be used to identify contamination and determine the areal extent of the source areas.
- To conduct gamma logging of all new well installations for stratigraphic correlation with older well installations at Beach Point.



Beach Point Test Site, APG-EA, Maryland

Focused Feasibility Study

- To conduct flow meter logging of existing and new well installations to determine lateral and vertical static flow conditions.
- To collect sediment samples adjacent to Beach Point.

2.2 SITE BACKGROUND

2.2.1 Previous Usage

Beach Point was the former location of several testing and production activities that may have contributed to environmental contamination in the Kings Creek/Bush River area.

These operations included the following major activities:

- Mobile and fixed-base clothing-impregnating plants were operated at Beach Point during and after World War II; these plants were used to treat clothing with a waxy material that provides resistance to penetration by chemical warfare agents such as mustard. The clothing-impregnating process involved several solvents (e.g., 1,1,2,2-tetrachloroethane) as well as the impregnating chemical CC2 (N,N'-dichlorobis(2,4,6-trichlorophenyl)urea) and chlorinated paraffin wax.
- Liquid rocket fuel testing, including the evaluation of fire and vapor suppression methods for these materials, was conducted in the northern area of the point from the early 1960s through the 1970s. Test materials included hydrazine, unsymmetrical dimethylhydrazine (UDMH), red fuming nitric acid (RFNA), nitrogen tetroxide, and other propellants and fuels.
- Pyrotechnic testing was performed by Chemical Research and Development Engineering Center (CRDEC) Research Directorate from the post-World War II period until about 1970; this testing included work with grenades and pots filled with obscurant smoke (white), with limited testing of colored smokes. Fog oil was also used extensively in smoke and pyrotechnic testing at Beach Point.

In addition to these major operations, Beach Point was also used for small-scale storage of lethal agents (G-agents) during the 1950s, and was used as a firing position for testing of 4.2-inch mortars in the 1940s. However, neither of these activities is considered to be of major environmental significance compared to the clothing-impregnating, pyrotechnical, and rocket-fuel testing.



Beach Point Test Site, APG-EA, Maryland
Focused Feasibility Study

More detailed descriptions of these operations and the types and quantities of waste they generated may be found in the Project Work Plan.

2.2.2 Previous Investigations/Sample Results

Previous investigations and sampling activities identified potential chemical contaminants in the groundwater, surface water, soil, and, to a limited extent, the sediment and biota.

Analysis of soil samples detected metals (iron, manganese, calcium, magnesium, sodium and arsenic) and two organic compounds, phenol and trichlorofluoromethane (TCFM). The measured concentration of metals in the soil appear to be within the background range for Eastern U.S. soils. The phenol and TCFM were found in trace amounts (less than 1 µg/g).

Groundwater data indicated the presence of chlorinated volatile organic compounds (VOCs), particularly 1,1,2,2-tetrachloroethane and trichloroethane; metals, including zinc, manganese, copper, silver, and nickel. No background data were available for comparing metals concentrations with the concentrations in nearby areas. However, some of the metals detected may be associated with clothing impregnating operations as well as pyrotechnic and smoke manufacturing. Of the VOCs, 1,1,2,2-tetrachloroethane predominated; like the other VOCs detected, it may have been a waste associated with the clothing-impregnating process.

Surface water analysis showed most major ions and nutrients within expected ranges, although relatively high concentrations of nitrate were found at all Beach Point locations. This may be the result of rocket fuel testing activities, however nitrate concentrations appear to be related in part to an upstream source in the Kings Creek drainage basin.

Other analytes detected and likely etiology are:

- Metals — Aluminum, iron, manganese, cadmium, lead, zinc, and mercury were detected at elevated concentrations. Several of these metals (e.g., zinc, aluminum and lead) may be related to past pyrotechnic/smoke testing activities.



Beach Point Test Site, APG-EA, Maryland

Focused Feasibility Study

- VOCs — Numerous VOCs were detected; 1,1,2,2-tetrachloroethane, trichloroethane, and tetrachloroethylene (PCE) predominate. Examples of other chlorinated VOCs found include 1,1-dichloroethane, trichlorofluoromethane, chloroform, and carbon tetrachloride. Examples of detected aromatic VOCs are ethylbenzene and toluene.

2.3 FIELD OPERATIONS

Field activities to be performed in conjunction with this task include the collection of groundwater, surface soil, subsurface soil, and sediment samples for chemical analysis. Soil borings will be drilled and monitoring wells will be installed in selected areas. Additionally, well logging and water level logging will be conducted. Tables 2-1 through 2-3 present a summary of the laboratory chemical analysis efforts for aqueous and nonaqueous samples. The number of surface soil samples and required analysis, if any, has yet to be determined (TBD).

2.3.1 Field Schedule

Field activities are expected to begin in November 1993. JEG provided oversight for the geophysical surveys performed by Argonne National Laboratory which began in May 1993.



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Beach Point Test Site, APG-EA, Maryland

Focused Feasibility Study

Table 2-1 SUMMARY OF LABORATORY CHEMICAL ANALYSIS EFFORTS FOR GROUNDWATER SAMPLES

Analysis		Method	Number of Samples	Number of QA Samples [*]		
				Duplicates	Rinse Blanks	Ambient Samples
Full Organic (Low or medium concentration)	Volatiles	CLP (OLM01.8): GC/MS	7	1	1	1
	Semivolatiles	CLP (OLM01.8): GC/MS	7	1	1	1
Full Inorganic (Low or medium concentration)	Total Metals	CLP (ILM02.0): ICAP, GFAA (As,Pb,Se), CVAA (Hg)	7	1	1	1
	Dissolved Metals	CLP (ILM02.0): ICAP, GFAA (As,Pb,Se), CVAA (Hg)	7	1	1	1
	Cyanide	CLP (ILM02.0): Colorimetry/Titration	7	1	1	1
Organosulfur compounds		USAEC Methodology	7	1	1	1
Organophosphorus compounds: DMMP and DIMP IMPA and MPA		USAEC Methodology	7	1	1	1
Thiodiglycol		USAEC Methodology	7	1	1	1
Explosives		USAEC Methodology	7	1	1	1
Total Phosphorus		USAEC Methodology	7	1	1	1

CVAA	Cold Vapor and Atomic Absorption Spectroscopy
GC	Gas Chromatography
GC-ECD	Gas Chromatography and Electron Capture Detector
GC-FPD	Gas Chromatography with Flame Photometric Detection
GC/MS	Gas Chromatography/Mass Spectroscopy
GFAA	Graphite Furnace Atomic Absorption Spectroscopy
HPLC	High Pressure Liquid Chromatography
HRGC/LRMS	High Resolution Capillary Column Gas Chromatography/Low Resolution Mass Spectrometry
IC	Ion Chromatography
ICAP	Inductively Coupled Argon Plasma Spectroscopy
*	A number of trip blanks, to be determined in the field, will be analyzed for VOCs. A trip blank will accompany each cooler containing samples for VOC analysis. A filter blank will also be collected and analyzed for each lot of filters.



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FINAL QUALITY ASSURANCE PROJECT PLAN

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Beach Point Test Site, APG-EA, Maryland
Focused Feasibility Study

Table 2-2 SUMMARY OF LABORATORY CHEMICAL ANALYSIS EFFORTS FOR SOIL SAMPLES

*Analysis		Method	Number of Samples	Number of QA Samples		
				Duplicates	Rinse Blanks	Ambient Samples
Full Organic (Low or medium concentration)	Volatiles	CLP (OLM01.8): GC/MS	10	1	1	1
	Semivolatiles	CLP (OLM01.8): GC/MS	10	1	1	1
	Pesticides/Aroclors	CLP (OLM01.8): GC-ECD	10	1	1	1
Full Inorganic (Low or medium concentration)	Total Metals	CLP (ILM02.0): ICAP GFAA (As,Pb,Se) CVAA (Hg)	10	1	1	1
	Cyanide	CLP (ILM02.0): Colorimetry/Titration	10	1	1	1
Dioxins/Furans		CLP (DFLM01.0): 8280 (HRGC/LRMS)	10	1	1	1
Herbicides		USAEC Methodology (HPLC&GC)	10	1	1	1
Organosulfur compounds		USAEC Methodology	10	1	1	1
Organophosphorus compounds: DMMP and DIMP IMPA and MPA		USAEC Methodology	10	1	1	1
Thiodiglycol		USAEC Methodology	10	1	1	1
Explosives		USAEC Methodology	10	1	1	1
Total Phosphorus		USAEC Methodology	10	1	1	1

CVAA Cold Vapor and Atomic Absorption Spectroscopy
GC-ECD Gas Chromatography and Electron Capture Detector
GC-FPD Gas Chromatography with Flame Photometric Detection
GC/MS Gas Chromatography/Mass Spectroscopy
GFAA Graphite Furnace Atomic Absorption Spectroscopy
HPLC High Pressure Liquid Chromatography
HRGC/LRMS High Resolution Capillary Column Gas Chromatography/Low Resolution Mass Spectrometry
IC Ion Chromatography
ICAP Inductively Coupled Argon Plasma Spectroscopy



Beach Point Test Site, APG-EA, Maryland

Focused Feasibility Study

Table 2-3 SUMMARY OF LABORATORY CHEMICAL ANALYSIS EFFORTS FOR SEDIMENT SAMPLES

Analysis		Method	Number of Samples	Number of QA Samples		
				Duplicates	Rinse Blanks	Ambient Samples
Full Organic (Low or medium concentration)	Volatiles	CLP (OLM01.8): GC/MS	14	2	1	1
	Semivolatiles	CLP (OLM01.8): GC/MS	14	2	1	1
	Pesticides/Aroclors	CLP (OLM01.8): GC-ECD	14	2	1	1
Full Inorganic (Low or medium concentration)	Total Metals	CLP (ILM02.0): ICAP GFAA (As,Pb,Se) CVAA (Hg)	14	2	1	1
	Cyanide	CLP (ILM02.0): Colorimetry/Titration	14	2	1	1
Dioxins/Furans		CLP (DFLM01.0): 8280 (HRGC/LRMS)	14	2	1	1
Herbicides		USAEC Methodology	14	2	1	1
Organosulfur compounds		USAEC Methodology	14	2	1	1
Organophosphorus compounds: DMMP and DIMP IMPA and MPA		USAEC Methodology	14	2	1	1
Thiodiglycol		USAEC Methodology	14	2	1	1
Explosives		USAEC Methodology	14	2	1	1
Total Phosphorus		USAEC Methodology	14	2	1	1

CVAA Cold Vapor and Atomic Adsorption Spectroscopy
GC-ECD Gas Chromatography and Electron Capture Detector
GC-FPD Gas Chromatography with Flame Photometric Detection
GC/MS Gas Chromatography/Mass Spectroscopy
GFAA Graphite Furnace Atomic Absorption Spectroscopy
HPLC High Pressure Liquid Chromatography
HRGC/LRMS High Resolution Capillary Column Gas Chromatography/Low Resolution Mass Spectrometry
IC Ion Chromatography
ICAP Inductively Coupled Argon Plasma Spectroscopy



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FINAL QUALITY ASSURANCE PROJECT PLAN

BPOAPPNL.FFS

3.0 ORGANIZATION AND RESPONSIBILITY

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Quality assurance goals for the Beach Point FFS will be achieved through proper planning, organization, review, communication of objectives, auditing, reporting, and corrective action. The QA program will be carried out by personnel knowledgeable in QA theory and practice. Facilities, equipment, and services which affect data quality or integrity will be routinely inspected and maintained, as required by Standard Operating Procedures (SOPs).

Implementation of the QAPP requires that the project staff maintain an awareness of contractual procedures and goals. It is the policy of JEG to provide a QA program to ensure that all information produced by its employees and subcontractors is valid and of known quality. QA program requirements cover all activities which generate environmental measurement data. These requirements include statements of completeness, comparability, representativeness, precision, and accuracy where applicable.

Program personnel will be familiar with the required conventions, formats, and schedules specified in documents pertinent to project activities. Data review personnel will review data for accuracy, where applicable.

Field and analytical methods and procedures used in measurement and monitoring efforts will conform to CLP and U.S. Army Environmental Center (USAEC), formerly the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), methodology where applicable. Field team members will possess the appropriate qualifications and training prior to collecting environmental samples. All measurement methods will be fully documented and will include quality control procedures.

The intended use of the data and the associated acceptance criteria for data quality will be determined before the data collection efforts begin. Reported data will include, when appropriate, statements of precision, accuracy, representativeness, completeness, and comparability. Data processing procedures will be documented, reviewed, and revised, as required to meet CLP and USAEC data quality parameters.



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3.1 RESPONSIBILITIES

EMO is ultimately responsible for the quality of data collected in support of this project. The EMO Program Manager delegates the applicable authority to the JEG Project Manager. Their responsibilities include:

- Overseeing and monitoring performance of the FFS program staff;
- Interfacing with the agencies;
- Liaison between EMO, JEG, and the designated subcontractor laboratories and other subcontractors;
- Effective implementation of the QA program; and
- Completion of corrective actions when indicated.

3.1.1 Project QA/QC

Responsibilities for implementation of the project QA program in accordance with QA/QC contractual obligations lies principally with JEG's Project Manager. JEG's Project Manager and QA Manager ensure that the reliability and validity of project activities and deliverables are in compliance with the project QA program. Specific responsibilities include the following:

- Initiating QA activities within the program to ensure that QC measures are being implemented and maintained;
- Ensuring all records, logs, SOPs, and analytical results are documented and maintained in a retrievable manner;
- Conducting periodic performance audits to ensure acceptable analytical performance;
- Preparing periodic quality reports, and QA sections of final reports; and
- Ensuring corrective action has been implemented and documented to preclude future occurrences of unacceptable performance.

The JEG QA Manager has the responsibility and the authority to communicate directly with the Program Manager, EMO, EPA, and the laboratories, as necessary, to resolve any conflicts deemed adverse to quality achievement.



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3.1.2 Field Activities

Responsibilities for implementation of the QA program in conjunction with field activities lies principally with the JEG Project Manager, who will ensure that all field team members possess appropriate qualifications and training prior to collecting the samples. Specific responsibilities include:

- Ensuring that sampling activities are consistent with the approach defined by the QA program, and USAEC and CLP guidelines;
- Ensuring that QC measures are being implemented and maintained;
- Ensuring that all records and logs are documented and maintained in a retrievable manner; and
- Specifying conditions requiring corrective actions and implementing the appropriate course of action.

3.1.3 Laboratory Activities

The laboratories providing chemical analytical support for the Beach Point FFS are being determined through competitive procurement processes. The laboratory task manager will be responsible for maintaining quality assurance of the laboratory in accordance with the laboratory QA/QC plan. Responsibilities include the following:

- Providing sufficient equipment, space, resources, and personnel to conduct analyses and implement the project and QA program;
- Submitting the required documented methods and laboratory certification prior to analyzing samples;
- Providing trained and qualified individuals and ensuring that custody, subsampling, and other handling procedures are adequate for the sample types received;
- Overseeing the quality of purchased laboratory materials, reagents, and chemicals to ensure that these supplies do not jeopardize the quality of analytical results;
- Ensuring the implementation of corrective action for any QA/QC deficiencies; and
- Providing for routine monitoring and checking of results and data packages.



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3.1.4 Data Review

The JEG QA Manager will be responsible for handling data review for all CLP data. The data review process includes the review of all laboratory control data to assure that QA protocols established by USAEC have been observed.

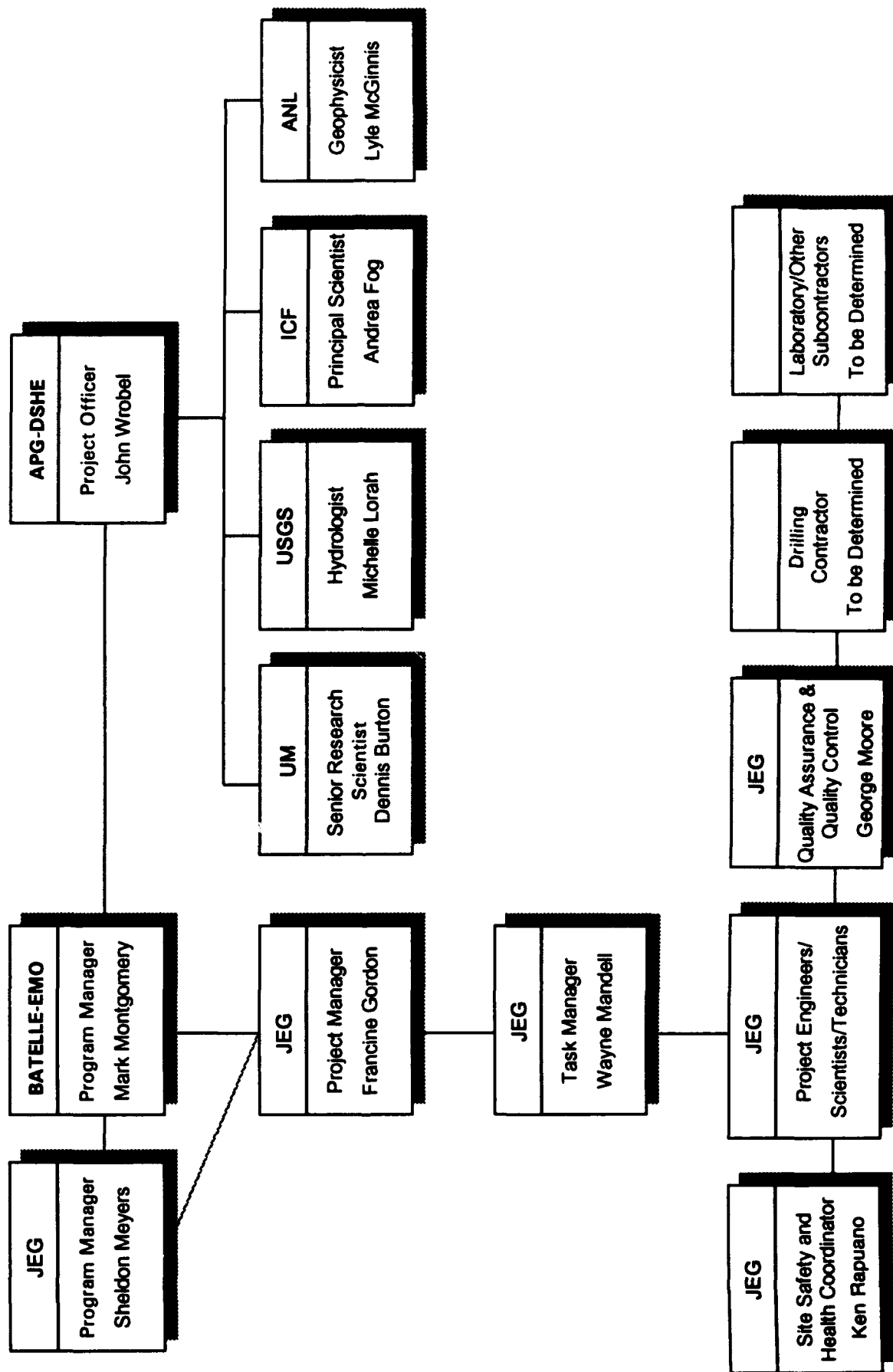
3.2 PROJECT ORGANIZATION

Figure 3-1 denotes the line of authority and project organization for the Beach Point FFS. Principal project participants and responsibilities for the project QA program reside in personnel from JEG.



FIGURE 3-1

BEACH POINT FFS- PHASE I
PROJECT MANAGEMENT ORGANIZATION



4.0 DATA QUALITY OBJECTIVES

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4.1 QUALITY ASSURANCE

The overall QA objective is to develop and implement procedures for sample and data collection, sample shipment, and reporting that will allow QA reviewers to determine, with reasonable certainty, whether the field and laboratory data collected during the FFS meet the criteria and endpoints established in the DQOs. The QA objective will be achieved through the implementation of specific procedures for sampling, field data collection, chain-of-custody, calibration, internal quality control, audits, preventative maintenance, and corrective actions as described in this QAPP. DQOs for chemical analyses are inherent in the CLP and USAEC methodologies to provide a 90 percent confidence level. The purpose of this section is to define QA goals for accuracy, precision, representativeness, completeness, and comparability in the field and in the laboratory.

4.1.1 Accuracy

Accuracy is the degree of agreement of a measurement (or an average of measurements of the same thing), X , with an accepted reference or true value, T , usually expressed as the difference between the two values, $X-T$, or the difference as a percentage of the reference or true value, $100 [(X-T)/T]$, and sometimes expressed as a ratio, X/T . Accuracy measures bias in a system.

For samples collected for chemical analysis, accuracy will be checked quantitatively through the use of spikes and blanks controlled by the laboratory. Accuracy of field measurements will be qualitatively controlled through the use of SOPs which have been developed to standardize the collection of measurements and samples. Consistent proper calibration of all equipment throughout the field exercises, as described in this QAPP, will assist in the accuracy of measurements. Field documentation and QA audits will be used to establish that protocols for sampling and measurement follow appropriate SOPs.

4.1.2 Precision

Precision refers to the level of agreement among repeated measurements of the same parameter. It is usually stated in terms of standard deviation, relative standard deviation,



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relative percent difference, range, or relative range. The overall precision of a piece of data is a mixture of sampling and analytical factors. The analytical precision is easier to control and quantify because the laboratory is a controlled, and therefore, measurable environment. Sampling precision is unique to each site, making it harder to control and quantify.

Precision will be evaluated by calculating the relative percent difference (RPD) as follows:

For samples collected for chemical analysis, sampling precision will be checked by obtaining one duplicate sample for every 10 samples collected for each type of media.

$$RPD=100\left(\frac{|XA-XB|}{XM}\right)$$

XA and XB are duplicate analyses, and XM is the mean value of duplicate analyses XA and XB.

The RPD will be calculated for each analytical parameter. It is expected that the duplicates for the organics will have RPDs of $\leq 25\%$. If these criteria are not met, a careful examination of the sampling techniques, sample media, and analytical procedure will be conducted to identify the cause of the high RPD and the usefulness of the data.

Laboratory precision will be addressed by analysis of duplicate samples by the contract laboratory. The RPD for each analytical parameter will be calculated as a measurement of precision. The National Functional Guideline Inorganic RPD standard of $\leq 20\%$ for water duplicates will be adopted as the criteria that the inorganic duplicates must meet. If these criteria are not met, an examination of the data similar to that described above will be conducted to determine the cause of the variability and usefulness of the data.

4.1.3 Representativeness

Representativeness is a measure of the degree to which the measured results accurately reflect the medium being sampled. It is a qualitative parameter which is addressed through the proper design of the sampling program in terms of sample location, number of samples, and actual material collected as a "sample" of the whole. Sampling protocols



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have been developed to assure that samples collected are representative of the media. Field handling protocols (e.g., storage, handling in the field, and shipping) have also been designed to protect the representativeness of the collected samples. Proper field documentation and QA audits will be used to establish that protocols have been followed and that sample identification and integrity have been maintained.

4.1.4 Completeness

Completeness is a measure of the amount of information that must be collected during the field investigation to allow for a successful achievement of the objectives. A certain amount and type of data must be collected for conclusions to be valid. Missing data may reduce the precision of estimates or introduce bias, thus lowering the confidence level of the conclusions. While completeness has been historically presented as a percentage of the data that is considered valid, this does not take into account critical sample locations or critical analytical parameters.

The amount and type of data that may be lost due to sampling or analytical error cannot be predicted or evaluated in advance. The importance of any lost or suspect data will be evaluated in terms of the sample location, analytical parameter, nature of the problem, decision to be made, and the consequence of an erroneous decision. Critical locations or parameters for which data are determined to be inadequate may be resampled. For this project, the criteria for completeness is set in the range between 80-100%. It is expected that a high level of data completeness will be achieved.

4.1.5 Comparability

Comparability is the confidence with which one data set can be compared to another. Comparability will be controlled through the use of SOPs which have been developed to standardize the collection of measurements and samples. Consistent proper calibration of all equipment throughout the field exercises, as described in this QAPP, will assist in the comparability of measurements. Field documentation and QA audits will be used to establish that protocols for sampling and measurement follow appropriate SOPs.



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4.2 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) have been developed for field activities to be conducted at Beach Point in accordance with EPA protocols for data quality objectives for remedial response activities. Elements of the following factors are presented in the summary of the DQOs provided in the Beach Point FFS Work Plan and are also shown in Table 4-1:

- The objectives of collecting data from the media associated with each field activity;
- The data types required to meet chemical and physical objectives. Included is the estimated number of data or samples that will be collected to meet the data objective;
- A description of the sampling method employed for each type of data;
- The use(s) for which data are being collected. This has been described by using general purpose categories which represent different data uses (e.g., Site Characterization and Risk Assessment);
- The identification of an appropriate analytical level for the analysis or measurement being performed. Five such levels have been defined by EPA for chemical analyses - these have been slightly modified to take into account physical measurements and laboratory certification;
- The analytical methods (CLP or USAEC) that will be employed to analyze samples;
- The typical detection limit or Certified Reporting Limit (CRL) requirements for the chosen analytical methods. The limits will always be lower than the levels of concern, where available. The levels of concern chosen for the sampling events are based on the freshwater ambient water quality criteria (AWQC), for surface waters, and the maximum contaminants levels (MCLs) in drinking water for groundwater. Tables 4-2 and 4-3 provide a detailed listing of levels of concern for groundwater and surface water media;
- The types of quality control samples that will be collected in association with each sampling medium; and
- The background locations and number of background samples to be collected.



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TABLE 4-1 DATA QUALITY OBJECTIVES FOR FIELD ACTIVITIES

DQO	Surveying and Establishing Grid System	Soil Gas and Geophysical Investigation	Hydrogeologic Investigation	Sediment Investigation	Surface Soil and Soil Boring Investigation	Biological/Ecological Investigation
Objective	Surveying and establishing a grid system will provide location information for geophysical surveys, soil gas surveys, and subsequent soil sampling and monitoring well installation activities within the Beach Point Test Site.	Soil gas (active and passive) and geophysical surveys (seismic and EM) will be performed to locate buried metal and other geophysical anomalies, estimate the depth to groundwater and presence of confining layers in areas where empirical data are not available, and identify areas containing elevated levels of contaminants within the soil gas phase. The final determination of monitoring well and surface soil sampling locations will be made.	New monitoring wells will be installed at deep and intermediate depth in the surficial aquifer clusters so that the vertical and horizontal profile of DNAPL distribution in the groundwater may be determined. Logging of new wells will provide a characterization of the stratigraphy and lithology of the Beach Point Test Site. Subsurface soil samples and groundwater samples will be collected and analyzed to determine the nature and extent of contamination. A water level elevation survey will be performed in order to construct a groundwater elevation map. Flow meter will be performed to determine the in-situ hydraulic conductivity and groundwater flow direction within the underlying aquifers.	Sediment data will be collected in Bush River to determine the extent to which past disposal practices have impacted pore water and sediment quality.	Surface and subsurface soil samples will be collected in areas to determine if contaminant transport is occurring from suspected source locations.	Chemical residue analysis to assess bioaccumulation of contaminants. Human exposure will be discussed qualitatively, not quantitatively.
Chemical Data	None	If soil gas samples are collected. Samples will be analyzed for a variety of analytes. Active soil gas samples will be analyzed for VOCs. Analyses for passive soil gas samples are still to be determined.	Groundwater and subsurface soil samples will be analyzed for TCL VOCs and BNA's, TAL inorganics (dissolved and total for groundwater), CSM breakdown products, explosives, pesticides/PCBs, herbicides, dioxins/furans, and total phosphorus.	<ul style="list-style-type: none"> Sediment samples will be analyzed for TCL VOCs, TCL BNA's, TAL inorganics, CSM breakdown products, explosives, pesticides/PCBs, herbicides (SED only), dioxins/furans, total organic carbon and total phosphorus. Well point samples will be analyzed for TCL VOCs and TAL inorganics. 	Surface soil samples will be analyzed for TCL VOCs and BNA's, TAL inorganics, CSM breakdown products. Refer to Hydrogeologic Investigation for discussion of soil boring chemical data.	Benthic tissue samples will be analyzed for BNA's, TAL inorganics, CSM breakdown products, explosives, pesticides/PCBs, herbicides, and dioxins/furans. Toxicity Tests. The mysid shrimp and the sheepshead minnow will be used as indicator species

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Table 4-1 (Continued)

DOO	Surveying and Establishing Grid System	Soil Gas and Geophysical Investigation	Hydrogeologic Investigation	Sediment Investigation	Surface Soil and Soil Boring Investigation	Biological/Ecological Investigation
Physical Data	<ul style="list-style-type: none"> Three permanent reference markers will be established at Beach Point surveyed to an accuracy of 1 foot in lateral coordinates and 0.01 foot in elevation. Grids with 20-foot cells, reproducible to 2 feet, will be established in the Beach Point Test Site for geophysical and soil gas surveys. All new and existing monitoring wells will be surveyed in elevation and coordinates. Accuracy 0.05 foot in National Vertical Datum and using an UTM (meters) or STP (feet) grid. 	<ul style="list-style-type: none"> Seismic data will include reflected radar signals for interpretation. EMI data- subsurface conductivities will be interpreted. 	<ul style="list-style-type: none"> Visual logging of 6 new wells. Natural gamma ray logging of all new wells for stratigraphic control and correlation. Temperature, Eh, pH, DO, turbidity, and conductivity measurements before, during, and after pre-sample purging. Flow meter logs will be performed in each of the current wells and the 6 new well installations. Water level measurements will be taken within a 24-hour period from all wells, accurate to 0.01 feet. Map coordinates for the sampling locations will be generated using GPS. 	<ul style="list-style-type: none"> Temperature, pH, and conductivity measurements will be collected prior to sampling. Grain size distribution will be determined on all sediment samples Map coordinates for the sampling locations will be generated using GPS. 	<ul style="list-style-type: none"> Visual characterization of soil types. Map coordinates for the sampling locations will be generated. 	<ul style="list-style-type: none"> None.
Sampling Method	<p>Chemical Data: No sampling to be performed.</p> <p>Physical Data: Biased, non-intrusive</p>	<p>Chemical Data: Field analysis of soil gas samples.</p> <p>Physical Data: Environmental, biased, non-intrusive</p>	<p>Chemical Data: Environmental, biased, grab, composite (subsurface soil from shallow borings only), and intrusive.</p> <p>Physical Data: Environmental, biased, grab, intrusive</p>	<p>Chemical Data: Environmental, biased, grab, and intrusive.</p> <p>Physical Data: Environmental, biased, grab and intrusive</p>	<p>Chemical Data: Environmental, biased, intrusive, composite (subsurface soil from shallow borings only)</p> <p>Physical Data: Environmental, biased, intrusive</p>	<p>Chemical Data: Environmental, biased, grab, and intrusive.</p> <p>Physical Data: Environmental, biased, grab, and intrusive</p>
Data Use	Site Characterization	Site Characterization/Source Identification	Site Characterization Risk Assessment	Site Characterization Risk Assessment	Site Characterization Risk Assessment	Site Characterization Risk Assessment



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Table 4-1 (Continued)

DOO	Surveying and Establishing Grid System	Soil Gas and Geophysical Investigation	Hydrogeologic Investigation	Sediment Investigation	Surface Soil and Soil Boring Investigation	Biological/Ecological Investigation
Analytical Data Level	All data will be equivalent to EPA Level I.	<ul style="list-style-type: none">Seismic and EMI data will be equivalent to EPA Level I.Soil gas data will be equivalent to EPA Level II.	<ul style="list-style-type: none">CLP-certified analyses will be equivalent to EPA Level IVUSAEC- and EPA-certified analyses will be equivalent to EPA Level III.Physical testing of soils will be equivalent to EPA Level V.Field screening physical data and logs will be equivalent to Level I.	<ul style="list-style-type: none">CLP-certified analyses will be equivalent to EPA Level IVUSAEC- and EPA-certified analyses will be equivalent to EPA Level III.Physical testing of soils will be equivalent to EPA Level V.Field screening physical data and logs will be equivalent to Level I.	<ul style="list-style-type: none">CLP-certified analyses will be equivalent to EPA Level IVUSAEC- and EPA-certified analyses will be equivalent to EPA Level III.Visual logging will be equivalent to EPA Level I.	<ul style="list-style-type: none">CLP-certified analyses will be equivalent to EPA Level IVUSAEC- and EPA-certified analyses will be equivalent to EPA Level III.Taxonomic classification will be equivalent to Level I
Analytical Method CLP, USAEC, EPA, and ASTM	No chemical or physical analytical data is required for surveying and grid establishment.	<ul style="list-style-type: none">No chemical or physical analytical data is required for geophysical data.Soil gas samples will be analyzed by non-certified, chemical specific USAEC, EPA, or ASTM methods.	<p>Chemical testing: CLP Methods-(OLM01.8, ILM02.0, DFLM01.0) 8280, 200.7M, 208.2M, 239.2M, 270.2M, 245.2M, 245.5M, 335.2M, 335.3M, GC/MS, and GC/ECD.</p> <p>USAEC Methods- Aqueous samples- Method numbers are laboratory specific. Solid samples- Method numbers are laboratory specific.</p> <p>Physical Testing: ASTM Methods for soil samples- D-422, D-2216, D-2487, D-2874, D-4318, and EPA method 9100.</p>	<p>Chemical testing: CLP Methods-(OLM01.8, ILM02.0, DFLM01.0) 8280, 200.7M, 208.2M, 239.2M, 270.2M, 245.5M, 335.2M, 245.5M, 335.3M, GC/MS, and GC-ECD.</p> <p>USAEC Methods- For solid samples- Method numbers are laboratory specific.</p> <p>Physical Testing: ASTM-certified methods for soil samples- D-422, D-2216, D-2487, D-2874, D-4318, and EPA Method 9100.</p>	<p>Chemical testing: CLP Methods-(ILM02.0, OLM01.8, DFLM01.0) 8280, 200.7M, 208.2M, 239.2M, 270.2M, 245.5M, 335.3M, GC/MS, and GC-ECD.</p> <p>USAEC Methods- For solid samples- Method numbers are laboratory specific.</p> <p>Bioassay Endpoints: Mysid Shrimp (<i>Mysidopsis bahia</i>)- survival after 48 hours Sheepshead Minnow (<i>Cyprinodon variegatus</i>)- survival after 48 hours.</p>	<p>Chemical testing: CLP Methods-(ILM02.0, OLM01.8, DFLM01.0) 8280, 200.7M, 208.2M, 239.2M, 270.2M, 245.5M, 335.3M, GC/MS, and GC-ECD.</p> <p>USAEC Methods- For solid samples- Method numbers are laboratory specific.</p> <p>Bioassay Endpoints: Mysid Shrimp (<i>Mysidopsis bahia</i>)- survival after 48 hours Sheepshead Minnow (<i>Cyprinodon variegatus</i>)- survival after 48 hours.</p>
Typical Detection Limit	None	Typically 1 ppb for VOCs in soil gas samples.	Typically 1 ppb for water and 1 ppm for soil.	Typically 1 ppb for water and 1 ppm for soil.	Typically 1 ppm.	Typically 1 ppm.
Quality Control Samples	None	Soil Gas: Performance evaluation samples, matrix spikes, and blanks. Geophysical: None.	Trip Blanks, Rinse Blanks, Duplicates, Filter Blanks, Ambient Blanks, Method Blanks, Internal Laboratory Standards	Trip Blanks, Rinse Blanks, Duplicates, Ambient Samples, Method Blanks, Internal Laboratory Standards	Rinse Blanks, Duplicates, Method Blanks, Ambient Samples, Internal Laboratory Standards	Rinse Blanks, Duplicates, Method Blanks, Ambient Samples, Internal Laboratory Standards Bioassays Control Group- must be 90% or greater. Three replicates per test concentration

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Table 4-1 (Continued)

DOQ	Surveying and Establishing Grid System	Self-Gas and Geophysical Investigation	Hydrographic Investigation	Sediment Investigation	Surface Soil and Soil Boring Investigation	Biological/Geological Investigation
Local Background Samples	None	None	Groundwater sample from well CC35A.	Two sediment samples each from Kings Creek and Bush River will be taken at locations upstream and downstream from Beach Point. Data must be evaluated carefully, taking into account tidal/storm influences on sediment.	Select soil sampling from boring program.	• Two background locations from Bush River and two as background to Kings Creek will be used for benthic background locations.

Note: DQO's from Phase III will be developed during Phase I and/or Phase II.

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Table 4-2. USEPA MCLs in Drinking Water
(used to establish levels of concern in groundwater samples)

Contaminant	Proposed MCLG(a) (mg/L)	Current MCL(b) (mg/L)	Proposed MCL(b) (mg/L)
INORGANICS			
Arsenic		0.05 ¹	
Antimony(c)	0.006 ⁸		.006 ⁸
Asbestos	8 million fibers/L ^{9,10}	7 million fibers/ L ^{9,5}	
Barium	2 ⁴	2 ⁵	
Beryllium(c)	0.004 ⁸		0.004 ⁸
Cadmium	0.005 ⁴	0.005 ⁶	
Chromium	0.1 ⁸	0.1 ⁶	
Copper	1.3 ⁴		
Cyanide(c)	0.2 ⁸		0.2 ⁸
Fluoride	4 ⁴	4 ⁶	
Lead	0 ⁴	0.05 ¹	
Mercury	0.002 ⁴	0.002 ^{1,5}	
Nickel(c)	0.1 ⁷		0.1 ⁸
Nitrate (as N)	10 ^{1,10}	10 ^{1,5}	
Nitrite (as N)	1 ^{1,10}	1 ^{1,5}	
Selenium	0.05 ⁸	0.05 ⁶	
Silver	--- ⁹	--- ⁹	--- ⁹
Sulfate(c)	400/500(g) ⁹		400/500(g) ⁹
Thallium(c)	0.0005 ⁸		0.002(d) ⁸
VOLATILE ORGANICS			
Benzene	0 ²	0.005 ⁵	
Carbon tetrachloride	0 ²	0.005 ⁵	
Chlorobenzene (Monochlorobenzene)	0.1 ²	0.1 ⁵	
1,2-Dichlorobenzene	0.6 ²	0.6 ⁵	
1,4-Dichlorobenzene		0.6 ⁵	
1,2-Dichloroethane	0 ²	0.005 ⁵	
1,1-Dichloroethylene	0.007 ²	0.007 ⁵	
cis-1,2-Dichloroethylene	0.07 ²	0.07 ⁵	
trans-1,2-Dichloroethylene	0.1 ²	0.1 ⁵	
Dichloromethane (Methylene chloride)*	0 ⁸		0.005 ⁸
1,2-Dichloropropane	0 ²	0.005 ⁵	
Ethylbenzene	0.7 ²	0.7 ⁵	



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Table 4-2 (Continued)

Contaminant	Proposed MCLG(a) (mg/L)	Current MCL(b) (mg/L)	Proposed MCL(b) (mg/L)
Styrene	0.1 ⁵	0.1 ⁵	
Tetrachloroethylene	0 ²	0.00 ⁵	
Toluene	1 ²	1 ⁵	
1,1,1-Trichloroethane	0.2 ²	0.2 ⁵	
1,1,2-Trichloroethane	0.003 ^a		0.005 ^a
Trichloroethylene	0 ²	0.005 ⁵	
Vinyl chloride	0 ²	0.002 ⁵	
Xylenes (total)	10 ²	10 ⁵	
PESTICIDES/HERBICIDES/PCBs/BASE-NEUTRAL-ACID EXTRACTABLES			
Acrylamide	0 ²		
Adipates	0.5 ⁷		0.5 ⁷
Alachlor	0 ²	0.002 ⁵	
Aldicarb	0.001 ³	0.003 ⁵	
Aldicarb sulfoxide	0.001 ³	0.004 ⁵	
Aldicarb sulfone	0.001 ³	0.003 ⁵	
Atrazine	0.003 ²	0.003 ⁵	
Carbofuran	0.04 ²	0.04 ⁵	
Chlordane	0 ²	0.002 ⁵	
2,4-D	0.07 ²	0.07 ⁵	
Dalapon	0.2 ^a		0.2 ^a
Dibromochloropropane	0 ²	0.0002 ⁵	
Dinoseb	0.007 ^a		0.007 ^a
Diquat	0.02 ^a		0.02 ^a
Endothall	0.1 ^a		0.1 ^a
Endrin	0.002 ^a	0.0002 ¹	0.002 ^a
Epichlorohydrin	0 ²		
Ethylene dibromide	0 ²	0.00005 ⁵	
Glyphosate	0.7 ^d		0.7 ^a
Heptachlor	0 ²	0.0004 ⁵	
Heptachlor epoxide	0 ²	0.0002 ⁵	
Heptachlorobenzene			
Hexachlorocyclopentadiene (HEX)	0.05 ⁷		0.05 ⁷
Lindane	0.0002 ²	0.0002 ⁵	
Methoxychlor	0.04 ²	0.04 ⁵	
Oxamyl (Vydate)	0.2 ⁷		0.2 ⁷



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Table 4-2 (Continued)

Contaminant	Proposed MCLG(a) (mg/L)	Current MCL(b) (mg/L)	Proposed MCL(b) (mg/L)
PAHs (i)	0 ⁷		0.0002
Polychlorinated biphenyls (PCBs)	0 ²	0.0005 ⁵	
Pentachlorophenol	0.2 ²	0.001 ⁵	
Phthalates (i)	0 ⁷		0.004 ⁷
Picloram	0.5 ⁸		0.5 ⁸
Simazine	0.004 ⁸		0.004 ⁸
2,3,7,8-TCDD (Dioxin)	0 ⁷		0.00000005 ⁷
Toxaphene	0 ²	0.003 ⁵	
2,4,5-TP (Silvex)	0.05 ²	0.05 ⁵	
1,2,4-Trichlorobenzene	0.009 ⁷		0.0009 ⁷
Trihalomethanes (total)		0.1 ¹	---
WATER QUALITY PARAMETERS			
Chloride	---	250	---
Odor	---	3 T.O.N.	---
pH	---	6.5-8.5 pH units	---
Total dissolved solids (TDS)	---	500	---

SOURCE KEY:

- 40 CFR 141.11, Effective 12/7/92
- 40 CFR 141.50, Effective 7/30/92
- 40 CFR 141.50, Effective 1/1/93
- 40 CFR 141.51, Effective 7/30/92
- 40 CFR 141.61, Effective 7/30/92
- 40 CFR 141.62, Effective 7/30/92
- 55 FR 30370 (Federal Register 7/25/90), Proposal
- 57 FR 31776 (Federal Register 7/17/92), Promulgated effective 7/17/94
- Removed from listing, effective 7/30/92; see 40 CFR 141.11.

NOTES:

- MCLG= Maximum Contaminant Level Goal (nonenforceable).
- MCL= Maximum Contaminant Level.
- Values correspond to practical quantitation limits (PQLs), which are, respectively, 10 and 5 times the method detection limit (MDL) for these chemicals for analysis; public comment is requested.
- Length greater than 10 μ m.
- Proposed MCL for the total of nitrate and nitrite = 10 mg/L.
- Public comment is requested on which value is preferable as a primary level.
- Public comment is requested on establishing MCLGs at zero and MCLs at PQLs for six additional polynuclear aromatic hydrocarbons (PAHs) that are probable human carcinogens: benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.
- Public comment is requested on adding butyl benzyl phthalate as a regulated compound with an MCLG and MCL at 0.1 mg/L.
- Secondary levels are nonenforceable taste, odor, or appearance guidelines.



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Table 4-3. USEPA ACUTE FRESHWATER AMBIENT WATER QUALITY CRITERIA
(used to establish levels of concern in surface water/sediment samples)

Analyte/Compound	Acute Freshwater Ambient Water Quality Criteria (µg/L) ¹
TCL Volatile Organic Compounds	
Benzene	5,300*
Bromodichloromethane	11,000 (u)
Bromomethane	11,000 (u)
Carbon tetrachloride	35,200*
Chlorobenzene	250 (o)*
Chloroform	28,900*
Chloromethane	11,000 (u)
Dibromochloromethane	11,000 (u)
1,2-Dichloroethane	118,000*
1,1-Dichloroethylene	11,600 (p)
trans-1,2-Dichloroethylene	11,600 (p)
1,2-Dichloropropane	23,000 (q)*
cis-1,3-Dichloropropylene	6,060 (q)*
trans-1,3-Dichloropropylene	6,060 (q)*
Ethylbenzene	32,000*
Tetrachloroethylene	5,280*
Toluene	17,500*
1,1,1-Trichloroethane	18,000 (s)
1,1,2-Trichloroethane	18,000 (s)
Trichloroethylene	45,000*
TCL Semivolatile Organic Compounds	
Acenaphthene	1,700*
Benzyl butyl phthalate	940 (z)
4-Bromophenyl phenyl ether	360 (v)
Bis(2-chloroethoxy)methane	11,000 (u)
Bis(2-chloroethyl) ether	360 (v)
Bis(2-chloroisopropyl) ether	360 (v)
4-Chloro-3-methylphenol	30*
TCL Semivolatile Organic Compounds (Continued)	
2-Chloronaphthalene	1,600 (t)
2-Chlorophenol	
4-Chlorophenyl phenyl ether	360 (v)
1,2-Dichlorobenzene	1,120 (o)*
1,3-Dichlorobenzene	1,120 (o)*
1,4-Dichlorobenzene	1,120 (o)*
2,4-Dichlorophenol	2,020*



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Table 4-3 (Continued)

Analyte/Compound	Acute Freshwater Ambient Water Quality Criteria (µg/L)¹
Diethyl phthalate	940 (z)
Di(2-ethylhexyl) phthalate	940 (z)
2,4-Dimethylphenol	2,120*
Dimethylphthalate	940 (z)
Di-n-butyl phthalate	940 (z)
Di-n-octyl phthalate	940 (z)
2,4-Dinitrophenol	230 (x)
4,6-Dinitro-2-methylphenol	230 (x)
Fluoranthene	3,980*
Hexachlorobenzene	250 (o)
Hexachlorobutadiene	90*
Hexachlorocyclopentadiene	7.0*
Hexachloroethane	980*
Isophorone	117,000*
Naphthalene	2,300*
Nitrobenzene	27,000*
2-Nitrophenol	230 (x)*
4-Nitrophenol	230 (x)*
N-Nitrosodiphenylamine	5,850 (w)
N-Nitrosodipropylamine	5,850 (w)
Pentachlorophenol	$e^{(1.005(pH)-4.830)}, 20^*$
Phenol	10,200*
Toxaphene	0.73
TCL Semivolatile Organic Compounds/Pesticides	
1,2,4-Trichlorobenzene	
2,4,5-Trichlorophenol	
Aldrin	3.0
alpha-BHC	100 (ff)*
beta-BHC	100 (ff)*
delta-BHC	100 (ff)*
gamma-BHC (Lindane)	100 (ff)*
Chlordane	2.4
4,4'-DDE	1,050 (cc)*
4,4'-DDT	1.1 (dd)
Dieldrin	2.5
Endosulfan I	0.22 (bb)
Endosulfan II	0.22 (bb)
Endrin	0.18
Heptachlor	0.52
Toxaphene	0.73



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Table 4-3 (Continued)

Analyte/Compound	Acute Freshwater Ambient Water Quality Criteria (µg/L) ¹
TCL Semivolatile Organic Compounds/PCBs	
PCBs	2.0
TAL Inorganics	
Antimony	9,000*
Arsenic, trivalent	360
Arsenic, pentavalent	850*
Arsenic, hexavalent	850*
Beryllium	130*
Cadmium	$e^{(1.128[n(H)]-3.826)}$; 3.9*
Chromium, trivalent	$e^{(0.819[n(H)]-3.888)}$; 1,700*
Chromium, hexavalent	16
Copper	$e^{(0.9422[n(H)]-1.464)}$; 18*
Cyanide	22
Lead	$e^{(1.273[n(H)]-1.480)}$; 82*
Mercury	2.4
Nickel	$e^{(0.8460[n(H)]-3.3612)}$; 1,400+
Selenium	260
Silver	
Thallium	1,400*
Zinc	$e^{(0.8473[n(H)]-0.8804)}$; 120+
Explosives	
1,3-Dinitrotoluene	330 (ee)*
2,4-Dinitrotoluene	330 (ee)*
2,6-Dinitrotoluene	330 (ee)*
Nitrobenzene	27,000*

- 1 Environmental Protection Agency (EPA). 1986. Quality Criteria for Water. EPA 440/5-86-001, Office of Water Regulations and Standards, Washington, DC. 1-hour average concentration, not to be exceeded more than once every 3 years on the average.
- * Insufficient data to develop criteria; Value presented is the Lowest Observed Effect Level (L.O.E.L.).
- + Where AWQC is pH dependent, the value was calculated using a pH of 7.8. Where the AWQC is hardness dependent, the value was calculated using a hardness of 100 mg/L.
- H Hardness
- TAL Target Analyte List
- TCL Target Compound List
- (c) AWQC value is for non-specific dichlorobenzenes.
- (p) AWQC value is for non-specific dichloroethylenes.
- (q) AWQC value is for non-specific dichloropropanes/dichloropropylenes.
- (r) AWQC value is for two non-specific tetrachloroethanes.
- (s) AWQC value is for non-specific trichloroethanes.
- (t) AWQC value is for non-specific chloronaphthalenes.
- (u) AWQC value is for non-specific haloethanes.
- (v) AWQC value is for non-specific haloethers.
- (w) AWQC value is for non-specific nitrosamines.
- (x) AWQC value is for non-specific nitrophenols.
- (y) AWQC value is for non-specific chlorinated phenols.
- (z) AWQC value is for non-specific phthalate esters.
- (aa) AWQC value is for non-specific dichlorobenzidines.
- (bb) AWQC value is for non-specific endosulfan.
- (cc) AWQC value is for non-specific DDE.
- (dd) AWQC value is for non-specific DDT.
- (ee) AWQC value is for non-specific dinitrotoluene.
- (ff) AWQC value is for non-specific BHC.



5.0 SAMPLING

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Sample labeling, container requirements, preservation, sample collection, sample custody, and field calibration are described in this section. Procedures described are designed to eliminate external contamination and to ensure data quality through the use of SOPs. References to methods of collection and detailed SOPs are provided in Appendix A.

5.1 SAMPLE NUMBERING AND SAMPLE LABELING

5.1.1 Sample Numbering

Each aqueous, solid sample, liquid sample, and soil gas sample will be assigned a unique sequential number at the time of sampling. The sample number will identify the sample matrix, the sample site identification and the sequential number of sample. The following eight sample matrices are included in the sampling program for this FFS:

- Groundwater samples will be identified by the prefix GW;
- Surface water samples will be identified by the prefix SW;
- Surface soil samples will be identified by the prefix SO;
- Soil boring samples will be identified by the prefix SB
- Sediment samples will be identified by the prefix SE;
- Sludge samples will be identified by the prefix SL;
- Soil gas samples will be identified by the prefix SG; and
- Liquid samples (other than GW or SW) will be identified by the prefix LI.

Each sample number will have a field length of eight places. The first two places in the sample number correspond to the matrix identifier discussed above. The next five places consist of either the monitoring well prefix or the operational cluster number and the specific sample location, either surveyed location in the case of monitoring wells or GPS-located sampling point for the other seven matrices. The last place corresponds to the type of sample; rinse blank (R), field blank (F), field duplicate (D), or actual sample (A). Samples can be further discriminated by sampling depth as noted on the COC and entered in IRDMIS. Two examples of sample numbers are identified below:



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- Groundwater sample - GWCC013D. This sample number corresponds to a duplicate groundwater sample taken at monitoring well CC-013.
- Soil boring sample - SB42003A. This sample number corresponds to a soil boring sample taken in Operational Cluster 42 at GPS location 003. The suffix shows that it is an actual sample (i.e., not a duplicate of QA/QC sample). The sample depth data field on the COC and entered into IRDMIS further discriminates the sample.

All soil gas samples will also have a unique identification number. Sample numbers will be documented in the instrument logbook, the field logbook, and in the instrument computer. In addition, the mass spectrometer control program for analysis of soil gas samples will warn the operator if duplicate sample numbers are entered into the system.

5.1.2 Sample Labeling

Each aqueous and solid sample will be assigned a unique sequential number at the time of sampling which will be permanently affixed to the sample container. The sample label will include the following information:

- Sample number and bar code;
- Sampling date;
- Preservative;
- Requested analyses;
- Sampler's initials;
- Installation name; and
- "Filtered" or "unfiltered" (for aqueous samples).

Labels will be covered with polyethylene tape to prevent the loss of the label during shipment. SOP 001 in Appendix A details procedures for completing sample labels. Figure 5-1 is a copy of the sample container label.



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Figure 5-1 Sample Container Label

This page intentionally left blank. A sample of the bar coded label will be supplied when the laboratory is selected.



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5.2 CONTAINERS

All sample containers will be certified clean prior to use in accordance with EPA and USAEC protocols. The sample containers to be used for the various analyses for the FFS are provided in tabular format for aqueous and solid samples in Tables 5-1 and 5-2, respectively. All container requirements follow USAEC and CLP specifications. Soil samples for physical analysis will be containerized in clean 1-liter glass jars.

5.3 SAMPLE PRESERVATION

Preservatives will be required to retard hydrolysis of chemical compounds and complexes, to reduce volatility of constituents, and to retard biological action during transit and storage prior to laboratory analysis. Preservatives will be added to appropriate samples at the time of collection. The preservatives required for samples collected during this project are contained in Table 5-1 (aqueous) and Table 5-2 (solid). Aqueous samples collected for VOC analysis will not be preserved. All samples will be transported to the laboratory in temperature controlled coolers. Blue ice or wet ice will be used to maintain the internal cooler temperatures of 4°C required for preservation of groundwater, surface water, soil, and sediment samples.

Procedures for sample preservation are described below:

- Preservatives will be added to samples either using a pipette or directly to the sample if vials of preservatives are used.
- The sample bottle will be capped, and the bottle gently agitated in order to homogenize the preservative throughout the sample.
- The sample bottle cap will be reopened and a small amount of the sample will be transferred to a beaker and the bottle will be closed.
- Either pH paper or an electronic pH meter will be used to determine the pH of the sample. pH paper or a pH meter will never be put directly into the sample bottle in order to avoid contamination from entering or leaving the sample.



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Table 5-1. SAMPLE BOTTLES, PRESERVATION, AND HOLDING TIMES FOR AQUEOUS SAMPLES

Analysis	Bottle Requirement-Volume	Required Headspace	Preservative	Holding Time
Volatile Organic Compounds	Type B, 40-mL	0%	Cool to 4°C	7 days
Semivolatile Organic Compounds	Type A, K, or H, 2-L	10%	Cool to 4°C	7 days to extraction (40 days after extraction)
Pesticides/PCBs	Type A, K, or H, 2-L	10%	Cool to 4°C	7 days to extraction (40 days after extraction)
Total Metals	Type C, H, or L 1-L	10%	HNO ₃ to pH < 2. Cool to 4°C	6 months, except Mercury (28 days)
Dissolved Metals	Type C or L 1-L	10%	HNO ₃ to pH < 2. Cool to 4°C	6 months, except Mercury (28 days)
Cyanide	Type C or L 1-L	10%	NaOH to pH > 12. Cool to 4°C	14 days
Explosives	2 1-L amber glass bottles	10%	Cool to 4°C	7 days to extraction (40 days after extraction)
CSM Degradation Products	3 1-L amber glass bottles	10%	Cool to 4°C	7 days to extraction (40 days after extraction)
Dioxins/Furans	2 1-L amber glass bottles	10%	Cool to 4°C	30 days to extraction (45 days to analysis)
Herbicides	2 1-L amber glass bottles	10%	Cool to 4°C	7 days to extraction (40 days after extraction)
Chloride	Type C	10%	Cool to 4°C	28 days
Fluoride	Type C	10%	Cool to 4°C	28 days
Sulfate	Type C	10%	Cool to 4°C	28 days
Nitrate/nitrite	Type C	10%	pH < 2. H ₂ SO ₄ Cool to 4°C	28 days
Total phosphorus	Type C	10%	pH < 2. H ₂ SO ₄ Cool to 4°C	28 days
Alkalinity	Type C	10%	Cool to 4°C	14 days
Hardness	Type C	10%	pH < 2. HNO ₃ or H ₂ SO ₄ Cool to 4°C	6 months
Total suspended solids	Type C	10%	Cool to 4°C	48 hours
Biological oxygen demand	Type C	10%	Cool to 4°C	48 hours
Chemical oxygen demand	Type C	10%	pH < 2. H ₂ SO ₄ Cool to 4°C	28 days
Ammonia	Type C	10%	pH < 2. H ₂ SO ₄ Cool to 4°C	28 days

- Type A** Container: 80-oz amber glass, ring handle bottle/jug, 38-mm neck finish.
Closure: White polypropylene or black phenolic, baked polyethylene cap, 38-430 size; 0.015-mm teflon liner.
- Type B** Container: 40-mL glass vial, 24mm neck finish.
Closure: White polypropylene or black phenolic, open-top, screw cap, 15-cm opening, 24-400 size.
Septum: 24-mm disc of 0.005-in teflon bonded to 0.120-in silicon for total thickness of 0.125-in.
- Type C** Container: 1-L high density polyethylene, cylinder-round bottle, 28-mm neck finish.
Closure: White polyethylene cap, white ribbed, 28-410 size; F217 polyethylene liner.
- Type H** Container: 1-L amber, Boston round, glass bottle, 33-mm pour-out neck finish.
Closure: White polypropylene or black phenolic, baked polyethylene cap, 33-430 size; 0.015-mm teflon liner.
- Type K** Container: 4-L amber glass, ring handle bottle/jug, 38-mm neck finish.
Closure: White polypropylene or black phenolic, baked polyethylene cap, 38-430 size; 0.015-mm teflon liner.
- Type L** Container: 500-mL high-density polyethylene, cylinder-round bottle, 28-mm neck finish.
Closure: White polypropylene cap, white ribbed, 28-410 size; F217 polyethylene liner.

* HCL is the normal preservative, however it should not be used when thiodiglycol is a suspected contaminant.



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Table 5-2. SAMPLE BOTTLES, PRESERVATES, AND HOLDING TIMES FOR SOLID SAMPLES

Analysis	Bottle Requirement- Volume	Required Headspace	Preservative	Holding Time
Volatile Organic Compounds	Type D, 120-mL	0%	Cool to 4°C	14 days
Semivolatile Organic Compounds	Type F or G, 3-oz.	10%	Cool to 4°C	7 days to extraction (40 days after extraction)
Pesticides and Aroclors	Type F or G, 3-oz.	10%	Cool to 4°C	7 days to extraction (40 days after extraction)
Total Metals	Type F or G, 3-oz.	10%	Cool to 4°C	6 months, except Mercury (26 days)
Cyanide	Type F or G, 1-L	10%	Cool to 4°C	14 days
Total Phosphorus	1 1-L polyethylene bottle	10%	Cool to 4°C	28 days
Explosives	2 1-L amber glass bottles	10%	Cool to 4°C	7 days to extraction (40 days after extraction)
CSM Degradation Products	3 1-L amber glass bottles	10%	Cool to 4°C	7 days to extraction (40 days after extraction)
Dioxins/Furans	2 1-L amber glass bottles	10%	Cool to 4°C	30 days to extraction (45 days to analysis)
Herbicides	2 1-L amber glass bottles	10%	Cool to 4°C	7 days to extraction (40 days after extraction)

Type D **Container:** 120-mL wide mouth glass vial, 48-mm neck finish.
Closure: White polyethylene cap, 48-400 size; 0.015-mm teflon liner.

Type F **Container:** 8-oz. short, wide mouth, straight-sided, flint glass jar, 70-mm neck finish.
Closure: White polypropylene or black phenolic, baked polyethylene cap, 48-400 size; 0.030-mm teflon liner.

Type G **Container:** 4-oz tall, wide mouth, straight-sided, flint glass jar, 48-mm neck finish.
Closure: White polypropylene or black phenolic, baked polyethylene cap, 48-400 size; 0.015-mm teflon liner.



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- If the proper pH has been reached, the sample bottle will remain closed. If the proper pH has not been reached, the sample bottle will be reopened, more preservative added, the bottle shaken, and the pH tested until the proper pH has been reached.

Preservatives will always be added after filtering (if applicable).

5.4 SAMPLE COLLECTION

Detailed procedures for collection of environmental samples for chemical analysis are provided as SOPs in Appendix A. The collection of samples will follow the protocols outlined in the FFS Work Plan and in the SOPs contained in Appendix A. All sampling, except for soil gas, will be performed by JEG field personnel; soil gas sampling and analysis will be performed by a qualified subcontractor selected through a competitive bid process. Collection of all samples will follow standard USEPA CLP and USAEC protocols. This section discusses the collection of quality control samples.

5.4.1 Quality Control Samples Collected in the Field

Field work for the Beach Point FFS will include the collection of several types of quality control samples. These samples will include duplicates, rinse blanks/equipment blanks, filter blanks, and trip blanks. This section describes the method of collection and frequency of field quality control blanks.

Duplicate samples will be taken from areas which are known or suspected to be contaminated and will consist of one sample per week or 10% of all field samples. Fractions for the same analytical parameters will always be collected consecutively.

Rinse blanks will be collected when the sampling equipment is decontaminated and reused in the field or when a sample collection vessel (bailer or beaker) will be used. A consistent volume of blank water (organic-free, deionized water) will be poured over the equipment (i.e., rinsing the equipment) collecting the water in a sample container. The rinse blank



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determines whether the decontamination procedure has been adequately performed and that there is no cross-contamination of samples occurring due to the equipment itself. Analysis of rinse blanks will be for all analytes of interest. Rinse blanks will be collected at a frequency of 5% of the total number of samples.

Filter blanks will be collected at a frequency of 1 per lot. Organic-free, deionized water will be run through the filter using the filtering apparatus used to filter groundwater samples. The water will be collected in the appropriate sample bottles following filtering.

Soil gas blanks² will be collected using ambient air filtered through a combination organic vapor and High Efficiency Particulate Absolute (HEPA) cartridge through the sampling apparatus prior to each day's sampling, after each sample, and at the conclusion of the day. This blank will verify that there is no contamination contribution by the components creating the sampling point or by the air in the field laboratory trailer. This will evaluate the potential for contamination to the samples by venting of any potential sources into the air. At the end of each eight hour analytical sequence, a calibration check with benzene gas will be run to verify instrument sensitivity.

Trip blanks will be provided by the contract laboratory and will consist of HPLC-grade water sealed in 40 mL teflon-lined septum vials. The trip blank is used to determine if any on-site atmospheric contaminants are seeping into the sample vials, or if any cross-contamination of samples is occurring during shipment or storage of sample containers. The trip blanks will accompany the aqueous samples for VOC analysis to the laboratory.

Samples of organic-free, deionized water will be collected weekly and submitted for analysis in order to ensure that contaminants are not being introduced by the decontamination water. The water will be collected in the appropriate sample container and submitted for analysis.

² It must be noted that alternate technologies may be used for soil gas sampling (if required). Therefore, the method of blank acquisition may differ. Any deviations from the above will be included upon selection of a soil gas technology.



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5.5 SAMPLE CUSTODY

Evidence of sample custody shall be traceable from the time the certified clean sample bottles leave the laboratory until filled sample bottles are transmitted back to the laboratory. To achieve this condition, custody seals and Chain-of-Custody (COC) documentation will accompany all sample bottles.

5.5.1 Custody Seals

Custody seals will be signed, dated, and affixed to all sample and shipment containers. Custody seals will be placed across the cooler opening once the container has been secured. Intact custody seals upon arrival to the laboratory will ensure integrity of the samples during shipment. Intact custody seals on containers received by the JEG Sample Coordinator will ensure integrity of the samples prior to shipment. The JEG Sample Coordinator will break the custody seals to verify/adjust the pH of the samples as necessary. All custody seals will be affixed to each sample container prior to packing for shipment.

5.5.2 Chain-of-Custody

COC forms will accompany sample containers in the field, during transit to the laboratory, and upon receipt by the laboratory. SOP 002 listed in Appendix A provides explicit details on the procedure for completing the form. An example of the COC form is provided in SOP 002.

After the sample containers are filled, the COC form will be completed in triplicate (carbonless copies), checked against the contents of the cooler, and the original (white) and the yellow copy will be placed in a plastic bag, and taped inside the secured container. The pink copy of the COC form will be retained by the JEG Sample Coordinator. The original COC form will be transmitted to the Project Manager by the laboratory after samples have been analyzed.



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5.5.3 Sample Receipt

Samples delivered to the laboratory will be accepted by the laboratory technician. Samples can be accepted Monday through Friday. Special arrangements will be required if Saturday delivery is necessary. COC for laboratory receipt will be established in the following manner:

- The carrier and the time of arrival is documented in the daily receipt log. The number of items on the COC is checked with the actual number received to ensure that all sample coolers arrived.
- Notation is made as to whether each shipping container (cooler) was sealed with custody seals.
- Each cooler is opened, the internal ambient temperature of each cooler taken, and the samples are itemized. A cooler receipt form (Figure 5-2) will be completed and returned to the JEG Sample Coordinator. All deviations are noted and reported to the laboratory QA Coordinator.
- Lot numbers will be assigned to the samples. Reference to USAEC and CLP field numbers will be documented in the appropriate logbook. All data are entered into the computer sample tracking system, with analyses required by holding-time specified dates.

5.5.4 Laboratory Receipt

Once the sample has been transmitted to the laboratory the following sequence of events will occur:

- The samples are recorded on the Sample Log-In Form to summarize all the information pertaining to the sample/order to instruct the laboratory on the proper analysis and reporting of samples.
- After the samples are logged in, they are assigned to the appropriate storage refrigerator.
- All transfers of samples into and out of storage are documented.
- Samples remain in secured storage until removed for sample preparation or analysis.
- A refrigeration log must be generated to ensure refrigerators/freezers are operating at the appropriate temperature. The log must indicate the ambient internal temperature as well as the initials of the person recording the reading and the date. Should the temperature fluctuate outside of the specified holding time temperature range, corrective action must be taken immediately.



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Figure 5-2 COOLER RECEIPT FORM

PROJECT: _____

Cooler received on _____ and opened _____ by _____

Temperature ____ °C _____ (signature)

- 1) Were custody seals on outside of cooler? ☐ Yes ☐ No
If Yes, how many and location(s) _____
- 2) Were date and signature on seal(s) correct? ☐ Yes ☐ No
- 3) Were custody papers taped to lid inside cooler? ☐ Yes ☐ No
- 4) Were custody papers properly filled out (ink, signed, etc.) ☐ Yes ☐ No
- 5) Did you sign custody papers in appropriate place? ☐ Yes ☐ No
- 6) Did you attach shipper's packing form to this form? ☐ Yes ☐ No
- 7) What kind of packing material was used? _____
- 8) Was sufficient ice used? ☐ Yes ☐ No
- 9) Were all bottles sealed in separate plastic bags? ☐ Yes ☐ No
- 10) Did all bottles arrive in good condition? ☐ Yes ☐ No
- 11) Were all bottle labels complete?
(No., date, analysis, preservative, sign., etc.) ☐ Yes ☐ No
- 12) Did all bottle labels agree with custody papers? ☐ Yes ☐ No
- 13) Were correct bottle used for tests indicated? ☐ Yes ☐ No
- 14) Were VOA vials checked for absence of air/headspace and noted if found? N/A ☐ Yes ☐ No
- 15) Was sufficient amount of sample sent in each bottle? ☐ Yes ☐ No
- 16) Were air volumes noted for air samples? N/A ☐ Yes ☐ No
- 17) Were initial weights noted for pre-weighed filters? N/A ☐ Yes ☐ No

Explain any discrepancies: _____

_____ was contacted on _____ by _____

to resolve discrepancies.



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5.6 FIELD EQUIPMENT CALIBRATION

The proper calibration and documentation of field equipment is designed to assure that the field equipment is functioning optimally. Equipment logbooks are required to record usage, maintenance, calibration, and repair. Calibration records will include the following information:

- Identification of the equipment;
- Procedures used for equipment calibration;
- Traceable standard (type);
- Calibration performed by: (name);
- Date;
- Results;
- Acceptance criteria; and
- Corrective action taken (if necessary).

5.6.1 Frequency of Field Calibration

Field instrumentation/equipment will be calibrated in the field according to the following schedule:

5.6.1.1 Photoionization Detectors (PID) and Flame Ionization Detectors (FID).

MICROTIP IS-3000 (PID); FOXBORO 128 (FID)

Calibrated per manufacturer instructions upon arrival to the site and daily while in the field. Measurements of background VOCs will be documented and the instrument zeroed out, the calibration gas will be added, the reading documented, and the instrument will be adjusted for proper calibration. The final reading will also be documented. Calibration protocols and measurement will be documented in a bound logbook that accompanies each instrument, as well as in the field logbook. Refer to SOPs 023 (FID) and 024 (PID) for additional information.



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5.6.1.2 Dissolved Oxygen, Oxidation/Reduction Potential, pH, Temperature, and Conductivity Meter. YS1 3800

Calibrated per manufacturer instructions upon arrival and departure from the site and daily while in the field. Meter will be calibrated more frequently if temperature changes by 5°C or more. All measurements will be documented at the end of the field parameter form logbook or in separate calibration log forms. Refer to SOP 043 for more information.

5.6.1.3 Calibration of Soil Gas Equipment. The active soil gas instrument will be calibrated daily prior to use and recalibrated at a minimum rate of once every 8 hours of operation. Prior to each analytical sequence an instrument blank (carrier gas) will be run to demonstrate that there is no contamination contribution from the equipment prior to analysis of a sample.

The Cp/MS and TD/GC/MS for passive soil gas analyses will be calibrated with perfluorotributylamine to establish the correct mass assignment and mass resolution prior to each analytical sequence.

5.6.2 Calibration Standards

Equipment will be calibrated with the appropriate standards specified below. Analytical accuracy is traceable to Standard Reference Materials (SRMs) from the National Institute of Standards and Technology (NIST).

- **Conductivity Solution:** 1,000 Microhm/CM (+/- 0.50%) at 25°C, .053% Potassium chloride, .0002% Iodine, and Water (CAS 7732-18-5).
- **pH Buffers:**
 - 4.00 +/- 0.01 @ 25°C, Color coded red. Potassium Hydrogen Phthalate (CAS 877-24-7), Formaldehyde (CAS 50-00-0), Water (CAS 7732-18-5).
 - 7.00 +/- 0.01 @ 25°C, Color coded yellow. Sodium Phosphate, Dibasic (CAS 7558-79-4), Potassium Phosphate, Monobasic (CAS 7778-77-0), Water (CAS 7732-18-5).
 - 10.00 +/- 0.02 @ 25°C, Color coded blue. Potassium tetraborate (CAS 1332-77-0), Potassium Carbonate (CAS 584-08-7), Potassium Hydroxide (CAS 1310-58-3), Sodium (di) Ethylenediamine Tetraacetate (CAS 6381-92-6), Water (CAS 7732-18-5).



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- **Photoionization Detector Standards:**
Isobutylene ($\text{I-C}_4\text{H}_8$) 100 ppm +/- 5%, balance: Air.
- **Organic Vapor Analyzer Standards:**
Methane (CH_4) 95 ppm +/- 5%, balance: Air.



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6.0 SAMPLE ANALYSIS

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Sample management, holding times, preparation, instrument calibration, analytical procedures, and data management procedures are discussed in this section.

6.1 SAMPLE MANAGEMENT

The subcontract laboratory will provide the following for field sampling operations:

- Certified clean sample containers with bar codes;
- Shipping containers;
- Sample preservatives;
- Blue ice (optional);
- Sample labels; and
- Custody seals.

6.1.1 Sample Container Cleaning

The integrity of sample containers is ensured by using certified clean sample containers. A copy of the certification for each lot of sample containers will be provided to the JEG Sample Coordinator. The Sample Coordinator will initial and note date of receipt on each certification. Each certification will be permanently bound in the appropriate log book. The sample containers to be used in this task are shown in Tables 5-1 and 5-2 of this QAPP.

6.1.2 Shipping Containers and Custody Seals

Certified clean sample bottles will be sent to the field in the clean shipping coolers which will be used for return of samples to the laboratory. Each sample cooler will contain packing material and sufficient double-bagged ice or Blue ice packs (optional) required to maintain a temperature of 4°C. Sample coolers will be sealed with chain-of-custody seals. In addition each sample container will have an associated chain-of-custody form (COC) and logbook entry. Refer to SOP 004 for more detailed procedures on packing and shipping of sample containers to the laboratory for chemical analysis.



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6.1.3 Sample Preservatives

Preservatives will be included in the shipping container sent to the field. Unused preservatives will be sent back to the laboratory in DOT-approved (Department of Transportation) containers when sampling has been completed.

6.2 SAMPLE HOLDING TIMES

Sample holding time (the time interval between sampling and analysis), during which a sample can be considered valid and representative of the sample matrix, is based on the analytes of interest. The allowable holding times for the analyses proposed for this project are shown in Table 5-1 (aqueous samples) and Table 5-2 (solid samples). The laboratory tracking system should be designed to ensure that holding times are not exceeded.

6.3 SAMPLE PREPARATION

Once the samples have been received by the laboratory, the information on the sample labels will be transcribed to a bound notebook. Sample receipt conditions, analytical parameters, analysis dates, and storage locations are entered into the existing laboratory data management system for each sample shipment. Analytical lots will be established and coding assigned in lot sequence during the logging-in stage. Samples will be securely stored at 4°C from the time of receipt through final analysis. Samples will be stored until released by the EMO Project Officer or until the end of the contract.

Samples will be prepared, extracted, and/or spiked with reference materials or surrogate standards, as required for each specific analytical method. Percent moisture will be determined for each soil or sediment sample.

Laboratory water used in the course of chemical analyses shall conform with specification in the USEPA CLP and USAEC QA Program (1990).



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6.4 CALIBRATION

Prior to sample analysis, chemical calibration of each target analyte must be performed to ensure analytical instrumentation is functioning within the established sensitivity range. Protocols defining the procedures and QC measurements for instrument calibration should be done in accordance with criteria specified by the USAEC QA Program (1990) and the USEPA CLP QA Program.

6.4.1 Initial Calibration of Laboratory Instrumentation

Initial calibrations for the methods to be used in this project are performed routinely by the laboratory. Initial calibrations are not required unless the instrument fails the daily calibration procedure.

6.4.2 Daily Calibration of Laboratory Instrumentation

Prior to analysis, all instruments will be calibrated to ensure that the instrument response has not changed from the previous calibration. Analysis should be performed on the highest concentration standard. A response within two standard deviations of the mean response for the same concentration, as determined from recertification, certification, and prior initial/daily calibrations, does not warrant recalibration of the system. Should the response fail the criteria, the daily standard must be reanalyzed. Failure of the second analysis requires initial calibration to be performed as specified in the USAEC QA Program (1990) and the CLP QA program.

6.5 SOLUTION VALIDATION

All calibration solutions and standards to be used in this program will be prepared and maintained under the normal laboratory standards tracking system. This system ensures preparation, checking, documentation, storage, and disposal of standards according to specified procedures and schedules appropriate for each analyte of interest.



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6.6 LABORATORY/FIELD ANALYTICAL PROCEDURES

USEPA CLP, USEPA SW-846, Standard Methods (SM), American Society for Testing and Materials (ASTM), and USAEC analytical methods will be used for analysis of samples, as applicable. Listings of specific chemicals for analysis are provided in Tables 6-1 through 6-6. The analytes involved in the active and passive soil gas survey are provided in Tables 6-7 and 6-8. This section briefly describes the analytical methodologies that will be employed for the FFS.

6.6.1 Methods for the Analysis of Aqueous and Solid Samples

6.6.1.1 Inorganic Analysis. TAL metals will be analyzed in accordance with USEPA CLP methodologies (USEPA 1991b). The metal constituents will be analyzed using one of the following methodologies: inductively coupled argon emission plasma spectroscopy (ICAP), graphite furnace atomic absorption spectroscopy (GFAA), or cold vapor atomic absorption (CVAA).

The ICAP method involves the simultaneous or sequential multi-element determination of trace elements in solution. The basis of the method is the measurement of atomic emission by optical spectrometry. Samples are nebulized and the aerosol that is produced is transported to the plasma torch where excitation occurs. Characteristic atomic-line emission spectra are produced by a radio-frequency inductively coupled plasma. The spectra are dispersed by a grating spectrometer and the intensities of the line are monitored by photomultiplier tubes. The photocurrents from the photomultiplier tubes are processed and controlled by a computer system.



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**Table 6-1 TCL VOLATILE ORGANIC COMPOUNDS
(CLP OLM01.8)**

Chemicals for Analysis	EPA Method	Chemicals for Analysis	EPA Method
Acetone	8240	1,2-Dichloropropane	8010
Benzene	8020	cis-1,3-Dichloropropylene	8010
Bromodichloromethane	8010	trans-1,3-Dichloropropylene	8010
Bromomethane	8010	Ethylbenzene	8020
2-Butanone (MEK)	8015	2-Hexanone	8240
Carbon disulfide	8240	Methylene chloride	8010
Carbon tetrachloride	8010	4-Methyl-2-pentanone	8015
Chlorobenzene	8010	Styrene	8020
Chloroethane	8010	1,1,2,2-Tetrachloroethane	8010
Chloroform	8010	Tetrachloroethylene	8010
Chloromethane	8010	Toluene	8020
Dibromochloromethane	8010	1,1,1-Trichloroethane	8240
1,1-Dichloroethane	8010	1,1,2-Trichloroethane	8010
1,2-Dichloroethane	8010	Vinyl Chloride	8010
1,2-Dichloroethylene (total)	8010	Xylenes (total)	8020



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**Table 6-2 TCL SEMIVOLATILE ORGANIC COMPOUNDS
(CLP OLM01.8)**

Chemicals for Analysis	EPA Methods	Chemicals for Analysis	EPA Methods
Acenaphthene	8100	Dibenz(a,h)anthracene	8100
Acenaphthylene	8270	Dibenzofuran	8270
Anthracene	8100	1,2-Dichlorobenzene	8010
Benz(a)anthracene	8100	1,3-Dichlorobenzene	8010
Benzo(b)fluoranthene	8100	1,4-Dichlorobenzene	8010
Benzo(k)fluoranthene	8100	3,3'-Dichlorobenzidine	8270
Benzo(g,h,i)perylene	8100	4,6-Dinitro-2-methylphenol	8040
Benzo(a)pyrene	8270	2,4-Dinitrophenol	8040
Butyl benzyl phthalate	8060	2,4-Dinitrotoluene	8090
Bis(2-Chloroethoxy)methane	8270	2,6-Dinitrotoluene	8090
Bis(2-Chloroethyl) ether	8270	Fluoranthene	8100
Bis(2-Chloroisopropyl) ether	M.N.A.*	Fluorene	8100
Bis(2-ethylhexyl) phthalate	8060	Hexachlorobenzene	8120
4-Bromophenyl phenyl ether	8370	Hexachlorobutadiene	8120
Carbazole	M.N.A.*	Hexachlorocyclopentadiene	8120
4-Chloroaniline	8270	Hexachloroethane	8120
4-Chloro-3-methylphenol	8040	Indeno(1,2,3-cd)pyrene	8100
2-Chloronaphthalene	8120	Isophorone	8090
2-Chlorophenol	8040	2-Methylnaphthalene	8270
4-Chlorophenyl phenyl ether	8270	2-Methylphenol	8270
Chrysene	8100	4-Methylphenol	8270
4-Nitrophenol	8040	Phenol	8040
N-Nitroso-di-n-propylamine	8270	Pyrene	8100
N-nitrosodiphenylamine	8270	1,2,4-Trichlorobenzene	8270
Pentachlorophenol	8040	2,4,5-Trichlorophenol	8270
Phenanthrene	8100	2,4,6-Trichlorophenol	8040

*M.N.A. = Method Not Available.



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**Table 6-3 TAL INORGANIC COMPOUNDS
(CLP ILM02.0)**

Chemicals for Analysis	EPA Methods	Chemicals for Analysis	EPA Methods
Aluminum	6010	Lead	6010
Antimony	6010	Magnesium	M.N.A.*
Arsenic	6010	Manganese	M.N.A.*
Barium	6010	Mercury	7470
Beryllium	60910	Nickel	6010
Cadmium	6010	Potassium	M.N.A.*
Calcium	M.N.A.*	Selenium	6010
Chromium	6010	Silver	6010
Cobalt	6010	Sodium	M.N.A.*
Copper	6010	Thallium	6010
Cyanide	9010	Vanadium	6010
Iron	M.N.A.	Zinc	6010

*M.N.A. = Method Not Available.



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**Table 6-4 TCL PESTICIDES/AROCLORS (PCBs)
(CLP OLM01.8)**

Chemicals	EPA Methods
Aldrin	8080
alpha-BHC	8080
beta-BHC	8080
delta-BHC	8080
gamma-BHC (Lindane)	8080
alpha-Chlordane	M.N.A.*
gamma-Chlordane	M.N.A.*
4,4'-DDD	8080
4,4'-DDE	8080
4,4'-DDT	8080
Dieldrin	8080
Endosunan 1	8080
Endosunan 11	8080
Endosunan sulfate	8080
Endrin	8080
Endrin aldehyde	8080
Endrin ketone	M.N.A.*
Heptachlor	8080
Heptachlor epoxide	8080
Methoxychlor	8080
Toxaphene	8080
AROCLOL-1016	8080
AROCLOL-1221	8080
AROCLOL-1232	8080
AROCLOL-1242	8080
AROCLOL-1248	8080
AROCLOL-1254	8080
AROCLOL-1260	8080

*M.N.A = Method not available



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Table 6-5 DIOXINS/FURANS AND EXPLOSIVE COMPOUNDS

Dioxins and Furans	EPA Methods	Explosives	EPA Methods
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	8280	Cyclotrimethylene trinitramine (RDX)	8330
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	8280	Cyclotetramethylene tetranitramine (HMX)	8330
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	8280	1,3-Dinitrobenzene	8330
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	8280	2,4-Dinitrotoluene	8330
1,2,3,6,7,8-Hexachlorodibenzofuran	8280	2,6-Dinitrotoluene	8330
2,3,4,6,8-Hexachlorodibenzofuran	8020	N-Methyl-N,2,4,6-tetranitroaniline (TETRYL)	8330
1,2,3,7,8,9-Hexachlorodibenzofuran	8280	Nitrobenzene	8330
Octochlorodibenzo-p-dioxin	8280	Nitroglycerin	8330
Octachlorodibenzofuran	8280	Pentaerythritol (PETN)	8330
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	8280	1,3,5-Trinitrobenzene	8330
1,2,3,7,8-Pentachlorodibenzofuran	8280		
2,3,4,7,8-Pentachlorodibenzofuran	8280		
2,3,7,8-Tetrachlorodibenzo-p-dioxin	8280		
2,3,7,8-Tetrachlorodibenzofuran	8280		



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Table 6-6 CSM DEGRADATION PRODUCTS, HERBICIDES, AND WATER QUALITY PARAMETERS

CSM Degradation Product	USAEC Methods
Benzothiazole	Note 2
1,4-Dithiane	Note 2
1,4-Oxathiane	Note 2
4-Chlorophenyl methylsulfone	Note 2
4-Chlorophenyl methyl sulfide	Note 2
4-Chlorophenyl methyl sulfoxide	Note 2
Dimethyl disulfide	Note 2
Diisopropyl methylphosphonate	Note 3
Dimethyl methylphosphonate	Note 3
Isopropyl methylphosphonic acid (IMPA)	Note 3
Methylphosphonic acid (MPA)	Note 3
Thiodiglycol	Note 1
TCPU	Dennis, 1983
Herbicides	USAEC Methods
Bromacil	M.N.A.*
2,4-D	Note 2
Silvex	Note 2
2,4,5-T	Note 2
Water Quality Parameters	Methods
Alkalinity	SM 2320, EPA 310.1
Ammonia	SM 4500
Chloride	SM 4110, EPA 9250
Fluoride	EPA 340.2
Nitrite	SM 4500, EPA 9200
Phosphates	SM 4500, EPA 365.3/300.0
Sulfates	SM 4110, EPA 9035
TSS	SM 2450, EPA 160.2
BOD	SM 5210
COD	SM 5220
TOC	SM 5310
Hardness	SM 2340

Note 1: USAEC method numbers are frequently laboratory specific. The methodology commonly employs liquid chromatography.
Note 2: USAEC method numbers are frequently laboratory specific. The methodology commonly employs gas chromatography.
Note 3: USAEC method numbers are frequently laboratory specific. The methodology commonly employs ion chromatography.

*M.N.A. = Method Not Available



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Table 6-7 ACTIVE SOIL GAS COMPOUNDS

Isoctane
1,1-Dichloroethylene
Carbon disulfide
Acetone
<i>trans</i> -1,2-Dichloroethylene
Carbon tetrachloride
Methyl ethyl ketone
Methylene chloride
Benzene
Trichloroethylene
Chloroform
1,1,2,2-Tetrachloroethane
Toluene
Ethylbenzene
<i>p</i> -Xylene
<i>m</i> -Xylene
<i>o</i> -Xylene
1,1,2-Trichloroethane
Styrene



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Table 6-8 PASSIVE SOIL GAS COMPOUNDS

HYDROCARBONS			
Aromatics (Benzene-Based) All aromatic hydrocarbons from C ₆ (benzene) to C ₁₂ (C ₆ alkyl benzene) including specifically identified:			
Benzene	Xylenes	Ethylbenzene	Propylbenzenes
Toluene	Ethyl toluenes	Trimethylbenzenes	
Alkanes (Aliphatic/Paraffins) All alkane hydrocarbons from C ₄ (butane) to C ₁₅ (pentadecanes), plus C ₂ (ethane), including alkanes with various alkyl groups attached. All cycloalkanes with various alkyl groups attached, including specifically:			
Ethane	Dodecanes	Cyclononanes	Ethylmethylcyclohexane
Butanes	Tridecanes	Cyclodecanes	Methyloctadecane
Pentanes	Octadecanes	Octylcyclopropane	Dimethylheptane
Hexanes	Cyclopropane	Methylcyclopentane	Dimethyloctane
Heptanes	Cyclobutanes	Methylpropyl cyclopentane	Ethylmethyloctane
Octanes	Cyclopentanes	Methylhexane	
Nonanes	Cyclohexanes	Trimethylhexane	
Decanes	Cycloheptanes	Methylcyclohexane	
Undecanes	Cyclooctanes	Trimethylcyclohexane	
Alkenes (Olefins) All alkenes from C ₃ (propylene) to C ₁₅ (pentadecene), including alkenes with various alkyl and other hydrocarbon groups attached. Also, C ₄ to C ₁₅ cycloalkenes, including those with various alkyl groups and other hydrocarbons attached, including specifically:			
Ethylene	Heptenes	Cyclopentene	Cyclodecene
Propylene	Octenes	Cyclohexene	Methylpentene
Butylenes	Nonenes	Cycloheptene	Methylcyclohexene
Pentenenes	Decenes	Cyclooctene	
Hexenes	Cyclobutylene	Cyclononene	
Dienes from C ₆ —C ₁₆	Alkynes from C ₆ —C ₁₆	Styrenes, including: Styrene Methylstyrene C ₂ —C ₆ styrenes	
Mixtures PETREX has detected and can characterize fresh and aged hydrocarbon mixtures, including:			
Gasolines leaded/unleaded	Aviation gasoline	Lubricants (light oils to greases)	Sea Oils
Diesel fuels	White gasoline	Cutting oils	Creosotes
Jet fuels (JP4/JP5)	Hydraulic fluids	Coolants	



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Table 6-8 (Continued)

VOLATILE HALOGENATED COMPOUNDS			
Vinyl chloride	Trichloroethanes	Dichloropropylenes	Trichlorotrifluoroethane
Chloromethane	Tetrachloroethane	Trichloropropylenes	Bromoform
Methylene chloride	Dichloropropanes	Chlorobenzene	Dibromoethane
Chloroform	Dichloroethylenes	Chlorotoluene	Bromodichloromethane
Carbon tetrachloride	Trichloroethylene	Dichlorodifluoromethane	Dibromochloromethane
Chloroethane	Tetrachloroethylene	Trichlorofluoromethane	Bromodichloropropane
Dichloroethanes			
SEMIVOLATILE ORGANICS			
Hexachloroethane	Hexachlorobenzene	C ₂ —C ₄ naphthalenes	Nitrobenzene
Hexachlorocyclohexane	Dibromochloropropane	Chlorophenols	Nitrotoluene
Hexachlorobutadiene	Phenol	Chloronaphthalenes	Dinitrotoluene
Hexachloropentadiene	Cresols	Chlorobenzotrifluoride	Anthracene
Dichlorobenzenes	C ₂ —C ₃ phenols	Dichlorobenzotrifluoride	Phenanthrene
Trichlorobenzene	Naphthalene	Trichlorobenzotrifluoride	Acenaphthalene
Tetrachlorobenzene	Methylnaphthalenes		
SULFUR COMPOUNDS			
Hydrogen sulfide	Sulfur dioxide	Carbon disulfide	Carbonyl sulfide
OTHER DETECTABLE COMPOUNDS			
Ethanol	Dimethyl butanol	Methylbutanone	Tridecanone
Methoxyethanol	Hexanol	Hexanone	Aldehydes
Propanol	Nonanol	Methylhexanone	Benzaldehyde
Butanol	Methyl ethyl ketone	Acetaldehyde	



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A background correction technique is utilized to compensate for variable background contribution to the determination of trace elements. Background is measured adjacent to analyte lines on samples during analysis. The position selected for the background intensity measurement, on either or both sides of the analytical line, will be determined by the complexity of the spectrum adjacent to the analyte line. The position used will be free of spectral interference and will reflect the same change in background intensity as occurs at the analyte wavelength measured. Background correction will not be required in cases of line broadening where a background correction measurement would actually degrade the analytical result. Interferences will also be recognized and appropriate corrections made.

In order to obtain reporting limits lower than those provided by the ICAP method, arsenic, lead, and selenium will be analyzed using GFAA. GFAA involves the digestion of a representative sample using nitric acid and hydrogen peroxide. The digestate is subsequently analyzed by GFAA using the optimum instrumental conditions for the analytes of interest.

In order to obtain reporting limits lower than those provided by the ICAP method, mercury will be analyzed by CVAA. CVAA analysis is based on absorption of radiation at 253.7 nm. A sample aliquot is initially digested with nitric acid to free any combined mercury. The mercury is then reduced to its elemental state and aerated from the solution into a closed system. The mercury vapor is passed through a cell positioned in the path of a mercury light source and the measured absorbance is proportional to the concentration of mercury in the sample.

Cyanide will be analyzed using a USEPA CLP method comparable to USEPA methods 335.2 and 335.3 (USEPA 1991b). The cyanide as hydrocyanic acid (HCN) is released from cyanide complexes by means of a reflux-distillation operation and absorbed in a scrubber containing sodium hydroxide solution. The cyanide ion in the absorbing solution is then determined by volumetric titration or colorimetry. In the colorimetric measurement, the cyanide is converted to cyanogen chloride (CNCl) by reaction with chloramine-T at a



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pH of less than eight without hydrolyzing to the cyanate. After the reaction is complete, color is formed on the addition of pyridine-pyrazolone at 578 nm for pyridine-barbituric acid. To obtain colors of comparable intensity, the sample and the standards will contain the same salt content. The titrimetric measurement uses a standard solution of silver nitrate to titrate cyanide in the presence of a silver sensitive indicator.

6.6.1.2 Organic Chemical Analyses. TCL volatile and semivolatile organic compounds will be analyzed using USEPA CLP methods (USEPA 1992). The method involves purging of environmental sample and volatile organic-free water containing surrogates and internal standards with helium gas (following extraction). The purging chamber is heated to a predefined temperature and the vapor transferred to a sorbent tube which effectively traps the volatile organic compounds. The constituents are then backflushed onto a packed gas chromatographic column that is temperature programmed to separate the organic constituents. The volatile compounds are then detected using a mass spectrometer operating in the electron impact and full scan mode.

Pesticides and PCBs will be analyzed by USEPA CLP method which employs use of gas chromatography with electron capture detector (GC/ECD) (USEPA 1991a). Identification of analytes is based on retention times and retention time data. Sample is extracted with hexane or methylene chloride and then injected into a GC equipped with a linearized ECD for separation and analysis. The methylene chloride extract is isolated, dried and concentrated after solvent substitution with methyl tert-butyl ether prior to analysis with GC.

Explosives and related compounds will be analyzed in soil and water using USAEC methodologies. Nitroglycerin (NG) and pentaerythritol tetranitrate (PETN) will be analyzed in soil and water using a USAEC method which employs RP-HPLC. The method for soil involves an initial extraction of the soil with acetonitrile in a sonic bath for two hours. Soil extracts are diluted 1/1 with aqueous CaCl_2 and filtered. The water samples are diluted with acetonitrile and filtered. Determination is by RP-HPLC on an LC-18 column (Supelco), using an eluent of 3/2 methanol-water at 1.5 mL/min, and UV detection at 220 nm.



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RP-HPLC will be employed for the determination of tetrazene in soil and water. The method involves extraction of soil samples with a mixed solvent containing water, methanol, and 1-decanesulfonic acid, sodium salt by shaking for five hours on a platform shaker followed by filtration. Water samples are prepared and filtered similarly. Determination is by ion-pairing RP-HPLC with UV detection at 280 nm.

Picric acid is determined in soil using a USAEC method which employs HPLC and UV detection. A measured weight of soil is placed in a serum vial and is extracted with aqueous methanol using a vortex mexer. The sample is filtered through a Rainin filter and the extract is analyzed by HPLC on a Zorbax column using UV detection with external standards.

All remaining explosives will be analyzed using HPLC (USAEC). The method employs solid phase extraction of 500 milliliters of an environmental aqueous sample or one gram of environmental solid sample using acetonitrile. The target analytes are separated by HPLC column using isocratic elution and detected using ultraviolet absorbance (UV) at 230 nanometers.

Chemical Surety Material (CSM) Degradation Products will be analyzed in soil and water using appropriate USAEC methodologies. Diisopropylmethylphosphonate (DIMP) and dimethylmethylphosphonate (DMMP), breakdown products of the nerve agent GB, will be analyzed in aqueous and solid samples using GC-FPD via USAEC methods. A measured volume of sample or extract is directly injected onto the gas chromatographic column. Chromatographic conditions are described which permit the separation and measurement of DIMP and DMMP in environmental aqueous or solid samples. Qualitative identification is performed using retention times, and quantitative analysis is performed using standard curves. Isopropylmethylphosphonic acid (IMPA) and methylphosphonic acid (MPA) will be analyzed using a USAEC ion chromatography method.

Thiodiglycol, a breakdown product of blister agent mustard, will be analyzed in aqueous and solid samples using HPLC by USAEC Methods. The environmental aqueous and solid



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samples are extracted as follows: (1) *Aqueous samples*- a measured volume of the sample is concentrated by boiling, and is passed through an Amberlight XAD-7 resin column and further concentrated by another boiling step. The extract is buffered and brought to volume with water; and (2) *Solid samples*- a measured weight of the sample will be extracted with alkaline methanol using a wrist-action shaker. A portion of the methanol is filtered, and removed by evaporation under a nitrogen stream. The extract is acidified and buffered, and brought to volume with water. Following extraction, liquid chromatography is used to permit the separation and measurement of the thiodiglycol in the extract from the environmental aqueous and solid samples. Analyte identification is performed using retention times, and quantitative analysis is performed using a standard curve of area counts.

The compound 1,4-dithiane, a breakdown product of blister agent mustard, will be analyzed in aqueous and solid samples using GC via USAEC methods. The method employs extraction of the water matrix with methylene chloride, solvent concentration using standard Kuderna-Danish techniques, and analysis using by gas chromatography using flame-photometric detection (FPD) in the sulfur mode.

Acetophenone and malononitrile will be analyzed using USEPA SW-846 methods 8270 and 8240, respectively (USEPA 1986a). Method 8270 for semivolatile organic compounds (acetophenone) uses a GC/MS with a capillary column technique. Method 8240 for volatile organic compounds (malononitrile) uses a purge-and-trap GC/MS procedure.

TCPU will be analyzed by HPLC using Dennis (1983). A sample of the dried sediment is extracted with a mixture of acetonitrile and dimethylformamide in a sonic bath. Following centrifugation of the extract, the supernatant phase is subjected to direct analysis by HPLC.

Dioxins and furans are analyzed via USEPA CLP method (USEPA 1991a). The method involves a matrix-specific extraction, analyte-specific clean-up, and high-resolution capillary column gas chromatography and low resolution mass spectrometry techniques (HRGC/LMRS).



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6.6.1.3 Water Quality Analyses. Water quality parameters include chloride, sulfate, nitrate/nitrite, total phosphorus, alkalinity, hardness, total suspended solids, biochemical oxygen demand, chemical oxygen demand, total organic carbon, and ammonia. All analytes will be determined using Standard Method (SM) protocols or equivalent EPA methods and include, but are not limited to, the use of ion chromatography (IC), cadmium-reduction, colorimetry, and titration.

Chloride, Fluoride, and sulfate concentrations will be determined by IC using SM Method 4110 (APHA et al. 1989). A portion of the water sample is injected into a stream of carbonate-bicarbonate eluant and passed through a series of ion exchangers. Analyte identification is performed using retention times, and quantitative analysis is performed using a standard curve of peak heights. Fluoride will be analyzed using EPA method 340.2.

Nitrate/nitrite in aqueous samples will be analyzed using an automated cadmium reduction method-SM Method 4500 (APHA et al. 1989). A sample is passed through a column containing granulated copper-cadmium to reduce nitrate to nitrite. The nitrite (plus reduced nitrate) is measured by diazotizing with sulfanilamide and coupling with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a highly colored azo dye, which is measured colorimetrically. Nitrite can be determined by elimination of the cadmium reduction column from the sampling train.

Total phosphorus will be analyzed by autoanalyzer in aqueous and solid samples by ascorbic acid method-SM Method 4500 (APHA et al. 1989). The persulfate digestion method will be used prior to analysis, which includes the heating of the sample in the presence of sulfuric acid and ammonium persulfate for 30 to 40 minutes. All forms of phosphate are converted to orthophosphate and the concentration is determined colorimetrically. Ammonium molybdate and potassium antimonyl tartrate react in an acid medium with dilute solutions of ortho-phosphate to form a heteropoly acid - phosphomolybdic acid. This complex is reduced to an intensely blue-colored complex by ascorbic acid. The color is proportional to the orthophosphate concentration.



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Alkalinity will be analyzed by the titration method-SM Method 2320 (APHA et al. 1989).

This method uses the volume of standard acid required to titrate a portion of the sample to a designated pH to extrapolate an alkalinity value.

Hardness will be analyzed by the EDTA (ethylenediaminetetraacetic acid and its sodium salts) titrimetric method-SM Method 2340 (APHA et al. 1989). This method measures the calcium and magnesium ions by the addition of EDTA to the sample which creates a color change when all calcium and magnesium have been complexed. A calculation provides the hardness value.

Total suspended solids (TSS) will be analyzed by SM Method 2540 (APHA et al. 1989).

The method involves the drying of samples at 103-105°C on a filter. The increase in weight of the filter represents the value of TSS present in the sample.

Biochemical oxygen demand (BOD) will be determined using SM Method 5210 (APHA et al. 1989). The method involves measuring the oxygen utilized during an incubation period of 5 days, following dilution. Dissolved oxygen (DO) is measured initially and after incubation, and the BOD is computed from the difference between initial and final DO.

Chemical oxygen demand (COD) will be determined using SM Method 5220 (APHA et al. 1989). The COD is used as a measure of the oxygen equivalent of the organic matter content of a sample that is susceptible to oxidation by a strong chemical oxidant. A sample is refluxed in a strongly acidic solution with a known excess of potassium dichromate. After digestion, the remaining unreduced potassium dichromate is titrated with ferrous ammonium sulfate to determine the amount of potassium dichromate consumed and the oxidizable organic matter is calculated in terms of oxygen equivalent.

Total organic carbon (TOC) will be determined by SM Method 5310 (APHA et al. 1989), organic molecules are broken down to single carbon units, converted to a single molecular form and then converted to carbon dioxide. The carbon dioxide may be measured directly



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by a nondispersive infrared analyzer, it may be reduced to methane and measured with a flame ionization detector, or the carbon dioxide may be titrated chemically. The exact method will be determined by the concentration of TOC expected in the sample. The persulfate-ultraviolet method is useful for the determination of trace levels of TOC and the wet-oxidation method is suitable only for water containing at least 0.1 mg nonpurgeable organic carbon per liter. If concentrations of TOC exceed 1 mg/L, a combustion infrared method will be used.

Ammonia will be determined using the ammonia-selective electrode method-SM Method 4500 (APHA et al. 1989), which uses a hydrophobic gas-permeable membrane to separate the sample solution from an electrode internal solution of ammonium chloride. Dissolved ammonia ($\text{NH}_{3(\text{aq})}$ and NH_4^+) is converted to NH_3 by raising the pH to above 11 with a strong base. NH_3 diffuses through the membrane and the internal solution pH is sensed by a pH electrode. The fixed level of chloride in the internal solution is sensed by a chloride ion-selective electrode that serves as the reference electrode. Potentiometric measurements are made with a pH meter having an expanded millivolt scale or with a specific ion meter.

6.6.2 Soil Gas Chemical Analyses

The soil gas investigations will be conducted by a subcontractor selected through a competitive bid process. This section of the QAPP will be completed upon award of the contract to the selected subcontractor. Quality assurance procedures for the analysis techniques selected will reflect current industry and regulatory guidelines.

6.6.3 Physical Analyses for Solid Samples

Soil and sediment samples will be collected and analyzed for selected physical analysis by ASTM Methods. Analyses may include percent moisture/percent solids, grain size distribution, Atterberg limits, total organic carbon, and Unified Soil Classification System (USCS) designation.



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Percent moisture will be determined using ASTM Method D-2216. This method involves the determination of the percent water mass in a known mass of undried soil by weighing the soil before and after drying in an oven controlled at 110°C. The water content of a material is defined as the ratio, expressed as a percentage, of the mass of "pore" or "free" water in a given mass of material to the mass of the solid material particles.

Grain size distribution will be determined using ASTM Method D-442. This method covers the quantitative determination of the distribution of particle sizes in soil. A No. 200 sieve is used to separate particles larger than 75µm from the soil, while the distribution of particles smaller than 75µm is determined by a sedimentation process, using a hydrometer to secure the necessary data.

Atterberg limits, including liquid limit, and plasticity index of soils, will be using ASTM Method D-4318. This method details the preparation of test specimens using a multipoint test with a wet preparation procedure.

Total organic carbon content will be determined using ASTM Method D-2974. This method involves the ignition of an oven dried soil or sediment sample in a muffle furnace. The weight of the sample is taken before and after ignition, and the organic mass is the difference of the two masses. The organic content (a percentage) is expressed as this difference divided by the weight of the sample before ignition.

Classification of soils will be based on laboratory determination of particle-size characteristics, liquid limit, and plasticity index using ASTM Method D-2487. The system is based on the Unified Soil Classification System (USCS).

6.6.4 CLP Contract Required Quantitation and Detection Limits (CRQLs and CRDLs)

The USEPA CLP has established quantitation limits equivalent to the concentration of the lowest calibration standard analyzed for each analyte. The quantitation limit differs from the detection limit in that the amount of material necessary to produce a detector response that can be identified and reliably quantified is greater than that needed to simply be



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detected above the background noise. The CRDL is the minimum level of detection acceptable under the contract Statement of Work (SOW). The specific quantitation limits provided in Tables 6-9 through 6-12 for volatile organic compounds, semivolatile organic compounds, pesticides/aroclor, and dioxins/furans are highly matrix dependent and thus may not always be achievable. Table 6-13 summarizes CRDLs for TAL inorganics.

6.6.5 USAEC Certified and Upper Reporting Limits

The lowest concentration that is reported for each analyte has been established in the USAEC program from a statistical analysis of spikes and blanks. This concentration, termed the Certified Reporting Limit (CRL), is the lowest value that can be reported within a 90% confidence limit. The Upper Reporting Limit (URL) for the certified range was developed during the method certification. Tables 6-14 through 6-16 present reporting limits for aqueous and solid samples for explosives, chemical agent breakdown products, herbicides, and water chemistry analytes.

Within the USAEC certification program, each laboratory is certified for a unique set of detection limits. Because a laboratory has not yet been chosen, laboratory detection limits have not been included in this QAPP. Quantitation limits for analyses quantified by USAEC methodologies will be included in this report when a laboratory is selected.

6.7 REFERENCE MATERIALS

Reference standards are required to generate certification data, calibrate instruments, spike analytical surrogates or standards, and prepare QC samples. These solutions must be of known concentration and purity to achieve the criteria necessary for validation of analytical analyses. Each reference material will contain a lot number. In the event a reference standard becomes contaminated, its origins can be traced by the JEG QA manager.

Standards used to conduct analyses will be either Standard Analytical Reference Materials (SARMs) or Interim Reference Materials (IRMs). SARMs that are developed and distributed by the Central QA Laboratory from the National Institute of Standards and



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Technology (NIST) will be the preferred standards. IRMs are not as rigorously characterized as SARMs.

Reference materials for metal analyses may be stored at room temperature in a locked storage area. Materials for organic analyses must be stored in a locked refrigerator at or below 4°C.

6.8 DATA VALIDATION, REDUCTION, AND REPORTING

6.8.1 Collection

Data are initially collected, converted to standard reporting units (i.e., $\mu\text{g/g}$ for solid media and $\mu\text{g/L}$ for aqueous media), and recorded in standard formats by project analysts. These project analysts conduct preliminary data analyses using a variety of methods and procedures. Because many analytical instruments are microprocessor controlled, some of the requisite analyses can be performed directly in the instrument's operating or outputting mode. Those instruments, interfaced to stand-alone computers or microprocessors, often permit data analysis programs to be written and modified to produce data formats specifically suited to end user requirements.

Data requiring manual recording, integration, and/or analysis may be converted to a more appropriate format prior to subsequent analyses. Through all stages and aspects of data processing, the data are double checked for translation or transcription errors and are initialed by both the recorder and the checker. The QA Manager or other designated individual not directly involved in the analysis reviews the data for acceptability.



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Table 6-9 CLP CRQLs FOR TCL VOLATILE ORGANIC COMPOUNDS

Analyte	IRDMIS Acronym	CRQLs	
		Solid-Low conc. (µg/kg)*	Aqueous (µg/L)
Methylene chloride	CH ₂ CL ₂	10.0	10.0
1,1-Dichloroethane	11DCLE	10.0	10.0
trans-1,2-Dichloroethylene	12DCE	10.0	10.0
1,1-Dichloroethylene	11DCE	10.0	10.0
Chloroform	CHCL ₃	10.0	10.0
1,2-Dichloroethane	12DCLE	10.0	10.0
1,1,1-Trichloroethane	111TCE	10.0	10.0
Carbon tetrachloride	CCL ₄	10.0	10.0
Trichloroethylene	TRCLE	10.0	10.0
Benzene	C ₆ H ₆	10.0	10.0
1,1,2-Trichloroethane	112TCE	10.0	10.0
Tetrachloroethylene	TCLEE	10.0	10.0
Toluene	MEC ₆ H ₅	10.0	10.0
Chlorobenzene	CLC ₆ H ₅	10.0	10.0
Ethylbenzene	ETC ₆ H ₅	10.0	10.0
1,2-Dichloropropane	12DCLP	10.0	10.0
cis-1,3-Dichloropropylene	C13DCP	10.0	10.0
Vinyl chloride	C ₂ H ₃ CL	10.0	10.0
Chloroethane	C ₂ H ₅ CL	10.0	10.0
Chloromethane	CH ₃ CL	10.0	10.0
Bromoform	CHBR ₃	10.0	10.0
Dibromochloromethane	DBRCLM	10.0	10.0
trans-1,3-Dichloropropylene	T13DCP	10.0	10.0



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Table 6-9 (Continued)

Analyte	IRDMIS Acronym	CRQLs	
		Solid-Low conc. (µg/kg)*	Aqueous (µg/L)
1,1,2,2-Tetrachloroethane	TCLEA	10.0	10.0
Bromodichloromethane	BRDCLM	10.0	10.0
Bromomethane	CH3BR	10.0	10.0
Acetone	ACET	10.0	10.0
Carbon disulfide	CS2	10.0	10.0
2-Butanone	MEK	10.0	10.0
4-Methyl-2-pentanone	MIBK	10.0	10.0
Styrene	STYR	10.0	10.0
Xylene	XYLEN	10.0	10.0

*Quantitation limits listed for solids are based on wet weight. The quantitation limits calculated by the laboratory, calculated on dry weight basis as required by contract, will be higher.



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Table 6-10 CLP CRQLs FOR TCL SEMIVOLATILE ORGANIC COMPOUNDS

Analyte	MCMCAS Acronym	CRQLs	
		Solid (µg/kg)	Aqueous (µg/L)
Phenol	PHENOL	330	10
Bis(2-chloroethyl) ether	B2CLEE	330	10
2-Chlorophenol	2CLP	330	10
1,3-Dichlorobenzene	13DCLB	300	10
1,4-Dichlorobenzene	14DCLB	330	10
1,2-Dichlorobenzene	12DCLB	800	10
2-Methylphenol	2MP	800	10
Bis(2-chloroisopropyl) ether	B2CIPE	330	10
4-Methylphenol	4MP	330	10
N-Nitrosodi(n-propyl)amine	NNDNPA	330	10
Hexachloroethane	CL6ET	800	10
Nitrobenzene	NB	330	10
Isophorone	ISOPHR	330	10
2-Nitrophenol	2NP	330	10
2,4-Dimethylphenol	24DMPN	330	10
Bis(2-chloroethoxy)methane	B2CEXM	330	10
2,4-Dichlorophenol	24DCLP	330	10
1,2,4-Trichlorobenzene	124TCB	330	10
Naphthalene	NAP	330	10
4-Chloroaniline	4CANIL	330	10
Hexachlorobutadiene	HCBD	330	10
4-Chloro-3-methylphenol	4CL3C	330	10
2-Methylnaphthalene	2MNAP	330	10
Hexachlorocyclopentadiene	CL6CP	330	10



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Table 6-10 (Continued)

Analyte	IRMS Acronym	CROs	
		Solid (µg/kg)*	Aqueous (µg/L)
2,4,6-Trichlorophenol	246TCP	300	10
2,4,5-Trichlorophenol	245TCP	800	25
2-Chloronaphthalene	2CNAP	330	10
2-Nitroaniline	2ANIL	800	25
Dimethyl phthalate	DMP	330	10
Acenaphthylene	ANAPYL	330	10
2,6-Dinitrotoluene	26DNT	330	10
3-Nitroaniline	3NANIL	800	25
Acenaphthene	ANAPNE	330	10
2,4-Dinitrophenol	24DNP	800	25
4-Nitrophenol	4NP	800	25
Dibenzofuran	FURANS	330	10
2,4-Dinitrotoluene	24DNT	330	10
Diethyl phthalate	DEP	330	10
4-Chlorophenyl phenyl ether	4CLPPE	300	10
Fluorene	FLRENE	330	10
4-Nitroaniline	4NANIL	800	10
4,6-Dinitro-2-methylphenol	46DN2C	800	10
N-Nitrosodiphenylamine	NNDPA	330	10
4-Bromophenyl-(phenyl)ether	4BRPPE	330	10
Hexachlorobenzene	CL6BZ	330	10
Pentachlorophenol	PCP	800	10
Phenanthrene	PHANTR330	330	10
Anthracene	ANTRC	330	10
Di(n-butyl) phthalate	DNBP	330	10



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Table 6-10 (Continued)

Analyte	IDMS Acronym	CRLs	
		Solid (µg/kg)*	Aqueous (µg/L)
Fluoranthene	FANT	330	10
Pyrene	PYR	330	10
Butyl benzyl phthalate	BBZP	330	10
3,3'-Dichlorobenzidine	33DCBD	330	10
Benz[a]anthracene	BAANTR	330	10
Di(n-octyl) phthalate	DNOP	330	10
Benzo[b]fluoranthene	BBFAN	330	10
Benzo[k]fluoranthene	BKFANT	330	10
Benzo[a]pyrene	BAPYR	330	10
Indeno(1,2,3-cd)pyrene	ICDPR	330	10
Dibenz[a,h]anthracene	DBAHA	330	10
Benzo[g,h,i]perylene	BGHIPY	330	10

*Quantitation limits listed for solids are based on wet weight. The quantitation limits calculated by the laboratory, calculated on dry weight basis as required by the contract, will be higher.



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Table 6-11 CLP CRQLs FOR PESTICIDES/AROCLORS

Analyte	IRDMIS Acronym	CRQL	
		Solid (mg/kg)*	Aqueous (µg/L)
alpha-BHC	ABHC	1.7	0.05
beta-BHC	BBHC	1.7	0.05
delta-BHC	DBHC	1.7	0.05
gamma-BHC (Lindane)	LIN	1.7	0.05
Heptachlor	HPLC	1.7	0.05
Aldrin	ALDRN	1.7	0.05
Heptachlor epoxide	HPCLE	1.7	0.05
Endosulfan I	AENSLF	1.7	0.05
Dieldrin	DLDRN	3.3	0.10
4,4'-DDE	PPDDE	3.3	0.10
Endrin	ENDRN	3.3	0.10
Endosulfan II	BENSLF	3.3	0.10
4,4'-DDD	PPDDD	3.3	0.10
Endosulfan sulfate	ESFSO4	3.3	0.10
4,4'-DDT	PDDDT	3.3	0.10
Endrin ketone	ENDRNK	3.3	0.10
Methoxychlor	MEXCLR	1	0.50
Endrin aldehyde	ENDRNA	3.3	0.10
alpha-Chlordane	ACLDAN	33.0	0.05
gamma-Chlordane	GCLDAN	6	0.05
Toxaphene	TXPHEN	33.0	5.0
AROCOLOR-1016	PCB016	33.0	1.0
AROCOLOR-1221	PCB021	33.0	2.0
AROCOLOR-1232	PCB232	33.0	1.0



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Table 6-11 (Continued)

Analyte	IRDMIS Acronym	CRQL	
		Solid (mg/kg)*	Aqueous (µg/L)
AROCOR-1242	PCB242	33.0	1.0
AROCOR-1248	PCB248	33.0	1.0
AROCOR-1254	PCB254	33.0	1.0
AROCOR-1260	PCB260	33.0	1.0

*Quantitation limits listed for solids are based on wet weight. The quantitation limits calculated by the laboratory, calculated on dry weight basis as required by the contract, will be higher.



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Table 6-12 CLP CRQLs FOR DIOXINS AND FURANS

Analyte	CRQLs	
	Solid (µg/kg)*	Aqueous (ng/L)
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1.0	10
2,3,7,8-Tetrachlorodibenzofuran	1.0	10
1,2,3,7,8-Pentachlorodibenzofuran	2.5	25
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.5	25
2,3,4,7,8-Pentachlorodibenzofuran	2.5	25
1,2,3,4,7,8-Hexachlorodibenzofuran	2.5	25
1,2,3,6,7,8-Hexachlorodibenzofuran	2.5	25
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	2.5	25
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	2.5	25
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	2.5	25
2,3,4,6,7,8-Hexachlorodibenzofuran	2.5	25
1,2,3,7,8,9-Hexachlorodibenzofuran	2.5	25
1,2,3,4,6,7,8-Heptachlorodibenzofuran	2.5	25
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	2.5	25
1,2,3,4,7,8,9-Heptachlorodibenzofuran	2.5	25
Octachlorodibenzo-p-dioxin	5.0	50
Octachlorodibenzofuran	5.0	50

*Quantitation limits listed for solids are based on wet weight. The quantitation limits calculated by the laboratory, calculated on dry weight basis as required by the contract, will be higher.



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Table 6-13 CLP CRDLs FOR TAL INORGANICS

Analyte	IRDMIS Acronym	CRDL*	
		Solid (mg/kg)**	Aqueous (µg/L)
Aluminum	AL	40	200
Antimony	SB	12	60
Arsenic	AS	2	10
Barium	BA	40	200
Beryllium	BE	1	5
Cadmium	CD	1	5
Calcium	CA	1,000	5,000
Chromium	CR	2	10
Cobalt	CO	10	50
Copper	CU	5	25
Cyanide	CN	2	10
Iron	FE	20	100
Lead	PB	1	3
Magnesium	MG	1,000	5,000
Manganese	MN	3	15
Mercury	HG	0.1	0.2
Nickel	NI	8	40
Potassium	K	1,000	5,000
Selenium	SE	1	5
Silver	AG	2	10
Sodium	NA	1,000	5,000



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Table 6-13 (Continued)

Analyte	IRDMIS Acronym	CRDL*	
		Solid (mg/kg)**	Aqueous (µg/L)
Thallium	TL	2	10
Vanadium	V	10	50
Zinc	ZN	4	20

*The 1991 CLP SOW does not state CRDLs for inorganics. The CRDLs presented for aqueous samples are representative only of the ICAP analysis because the CRDLs for other analyses are not specified. The CRDLs presented for soil originated from the 1987 CLP SOW and represent ICAP analysis, with the exception of: GFAA for arsenic, selenium, and lead; CVAA for mercury; and autoanalyzer for cyanide.

**Quantitation limits for solids are based on wet weight. The quantitation limits calculated by the laboratory, calculated on dry weight as required by the contract, will be higher.



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Table 6-14 USAEC REPORTING LIMITS FOR EXPLOSIVES

Analyte	IRDMIS Acronym	Certified Reporting Limit		Upper Reporting Limit	
		Solid (µg/g)	Aqueous (µg/L)	Solid (µg/g)	Aqueous (µg/g)
Nitrobenzene	NB	2.41	1.07	27.4	54.9
1,3-Dinitrobenzene	13DNB	0.496	0.519	24.8	40.1
1,3,5-Trinitrobenzene	135TNB	0.448	0.626	24.4	42.1
2,4,6-Trinitrotoluene	246TNT	0.456	0.588	22.8	40.2
2,4-Dinitrotoluene	24DNT	0.424	0.612	21.2	40.2
2,6-Dinitrotoluene	26DNT	0.524	1.15	26.2	52.4
Nitroglycerin	NG	4.00	NA	200	NA
Pentaerythritol tetranitrate	PETN	4.00	NA	80	NA
Cyclotetramethylene tetranitramine	HMX	0.666	1.65	33.3	28.9
Cyclotrimethylene trinitramine	RDX	0.587	2.11	21.9	43.9
N-Methyl-N,2,4,6-tetranitroaniline	TETRYL	0.731	0.556	20.2	44.5

NA Not applicable; these compounds are not certified in the aqueous analysis of explosives.



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Table 6-15 USAEC REPORTING LIMITS FOR CSM DEGRADATION PRODUCTS AND TOTAL PHOSPHORUS

Analyte	IRDMIS Acronym	Solid (µg/g)		Aqueous (µg/L)	
		Certified	Upper	Certified	Upper
1,4-Dithiane	DITH	1.47	11.3	1.11	22.2
1,4-Oxathiane	OXAT	0.856	17.1	1.98	39.5
u-Chlorophenyl methylsulfone	CPMS02	2.37	47.4	4.72	106
u-Chlorophenyl methyl sulfide	CPMS	1.08	21.6	1.26	25.3
u-Chlorophenyl methyl sulfoxide	CPMSO	2.25	45.0	4.23	106
Benzothiazole	BTZ	1.08	13.2	2.11	42.2
Dimethyl disulfide	DMDS	0.692	13.8	1.14	22.8
Diisopropyl methylphosphonate	DIMP	0.114	4.57	10.5	210
Dimethyl methylphosphonate	DMMP	0.133	4.18	15.2	305
Methylphosphonic acid	MPA	2.0	40	128	9,000
Isopropyl methylphosphonic acid	IMPA	2.1	40	100	9,000
Thiodiglycol	TDGCL	3.94	102	187	4,880
Total phosphorus	TPO4	7.49	100	13.3	500

Table 6-16 CLP REPORTING LIMITS FOR HERBICIDES

Analyte	IRDMIS Acronym	Solid (µg/g)	Aqueous (µg/L)	
			CRL	URL
Bromocil	BRMCL	0.97	TBD	TBD
2,4-D	24D	0.02	0.802	2.52
2,4,5-T	245T	TBD	TBD	TBD
Silvex	SILVEX	0.008	0.170	1.36

TBD To Be Determined



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6.8.2 Validation

Data validation is the process whereby data are determined to be of acceptable or unacceptable quality based on a set of predefined criteria. The criteria for the data are dependent upon the referenced sampling and analytical methodologies which include the associated QA/QC requirements. The guidelines for the validation process are given in **Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses** (Viari, 1988b) and **Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses** (Viari, 1988a) with EPA Region III modifications.

An independent review of data packages will be performed to ensure compliance with specified analytical, QA, and data reduction procedures; data reporting requirements; and required accuracy, precision, and completeness measures. The following items may be reviewed to validate the data:

- Sample holding times;
- Documentation that the analytical results are in control and within the certified (linear) range of the analysis;
- Documentation that data and calculations were checked by a reviewer who was not involved in the performance sampling, analysis, or data reduction;
- Qualitative and quantitative data used in determining the presence and concentration of the target compounds;
- Calibration data associated with specific methods and instruments;
- Routine instrument checks (calibration, control samples, etc.);
- Documentation on traceability of instrument standards, samples, and data;
- Documentation on analytical methodology and QC methodology;
- The potential presence of interferences in analytical methods (check of reference blanks and spike recoveries);
- Documentation of routine maintenance activity to ensure analytical reliability; and
- Documentation of sample preservation and transport.

All data generated will be assessed for accuracy, precision, and completeness. Data assessment techniques will include routine quality control checks and system audits.



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Accuracy will be assessed from measurements of NIST SRMS or samples spiked with known concentrations of reference materials. The assessment for accuracy will be independent of the routine calibration process (e.g., reference materials will be obtained from independent sources and will be prepared independently). Control charts will be maintained to provide a timely assessment of precision of measurement functions.

6.8.3 Reduction

Data reduction frequently includes computation of analytical results from raw instrument data and summary statistics, including standard errors, confidence intervals, test of hypothesis relative to the parameters, and model validation.

Data reduction procedures that the laboratory will utilize address the reliability of computations and the overall accuracy of the data reduction. The numerical transformation algorithms used for data reduction will be verified against a known problem set to ensure that the reduction methods are correct.

The equations and the typical calculation sequence that should be followed to reduce the data to the acceptable format are instrument- and method-specific. Where standard methods are modified, data reduction techniques will be described in a report accompanying the data.

Auxiliary data produced for internal records and not reported as part of the analytical data include the following: laboratory work sheets, laboratory notebooks, sample tracking system forms, instrument logs, standard records, maintenance records, calibration records, and associated quality control. These sources will document data reduction and will be available for inspection during audits and to determine the validity of data.

Outliers will be identified by the MRD, USAEC, or CLP control chart program. The rationale used for data acceptance or rejection will be described and documented.



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6.8.4 Reporting

Chemical data shall be reported in the USAEC Installation Restoration Data Management Information System (IRDMIS) or other client specified data management system. The analyst shall quantify each analyte in the method blank and spiked QC sample each day of analysis. Method blank data shall generally be reported as "less than" the CRL for each analyte. Values detected above CRL shall be reported as determined, with entry into the data management system in terms of concentration. Processing of additional sample lots will not occur until the results of the previous lots have been calculated, plotted on control charts as required, and the entire analytical method shown to be in control. Detailed description of IRDMIS is provided in Section 7.0 of this QAPP.



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7.0 IRDMIS

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The Installation Restoration Data Management Information System (IRDMIS) is an integrated system for the collection, validation, storage, retrieval, and presentation of USAEC Installation Restoration Program (IRP) and base closure data. IRDMIS PC Tool provides the ability to enter chemical, geotechnical, and map file data. Each contractor is supplied with the appropriate microcomputer-based software to allow for record entry, error checking, and quality control for chemical, geotechnical, and map file data. Records accepted by the local error checking program are then transmitted through a Bulletin Board System (BBS) AT&T Model 3B2 minicomputer, which is centrally located at USAEC's Edgewood, MD facility. Subsequent processing at the central site (duplicate error check) results in an elevation of the accepted records to a higher file "level" and the eventual updating of installation-specific data bases in a Pyramid system.

7.1 DATA MANAGEMENT

There are three levels of data recognized in the IRDMIS. Level 1 consists of all files on the JEG microcomputer that have been entered or generated by the error checking program. The only Level 1 files that are present on the Pyramid system are program files. Program files are composed of several elements. An element may contain various contractor-written utilities or programs, add-streams, or other commonly used sets of commands.

It is anticipated that error-free files will be transmitted on a weekly basis to the Pyramid system. The JEG terminal will be linked to the network using software supplied by USAEC and a Hayes modem. Terminal usage logs will be established and maintained as a permanent record of communications. If communications cannot be established and maintained, JEG will seek optional means, where needed, for forwarding the data to USAEC. To verify acceptance, each file will be processed through an error checking program that is identical to the one on JEG's microcomputer. Accepted files will then be sent to the Pyramid. Should any files fail this final error check, JEG will be notified and required to correct detected errors and retransmit the data.



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Upon arrival at the Pyramid system, the files will be classified as Level 2 files. These records will be protected by write keys and, therefore, they may not be modified by JEG. They may be read by JEG, provided the appropriate read key is specified. All Level 2 files will be the responsibility of USAEC. Level 2 files will exist only until the data are loaded into the appropriate installation data base; normally within 10 working days.

Data in the installation data base are considered Level 3 data. They may be accessed by JEG using USAEC-supplied report programs and the appropriate read key; however, they are protected from changes by a write key. The installation data bases are the responsibility of USAEC.

Data management will begin when JEG transmits a request for analytical services to the laboratory, stating the number, type, sample numbers, methods for analysis, and any other information necessary for the laboratory to plan a particular job. Data files of initial input information, including map location files, a certification status check, sample ID number, parameters, dates and other items will be established as sample containers and chain of custody documentation are prepared for shipment to the field sampling team.

While in the process of collecting, documenting, packaging, and shipping samples to the laboratory, the field sampling team will transfer sample data from their notebooks to field parameter forms. Once the samples arrive at the laboratory, this information will be used to create Level 1 data files in the IRDMIS. Status information (e.g., date sampled, date received, data extraction/analysis due) will form a part of the record.

Each step in the analytical process will result in updates to the data files. The operation performed (e.g., preparation, extraction, analysis, data review, data package prepared), the data obtained, and the date that each step was completed will be entered into the system and made available for status checks. The laboratory will validate the data, perform error-checking and correction using the USAEC routines, and transmit the Level 1 files to USAEC, via the 3COM communications network. Hard-copy documentation will also be transferred from the laboratory to USAEC.



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Once the Level 1 files have been processed at USAEC, the Project Data Coordinator (PDC) will transmit any required corrections, then generate a backup tape copy. This step will be completed within 50 days after the samples have been collected. The laboratory will archive copies of all analytical data, including original instrument magnetic tapes, in perpetuity. Records will also be maintained, so that historical summaries of all analyses may be generated by site, by client, or by sample type. Refer to Figure 7-1 for a summary diagram of how this data will be handled.

7.2 PROJECT DATA

Data for entry into the IRDMIS and generated during this project will consist of geotechnical data and sampling/analytical data. The types, origin, IRDMIS files, and handling of these data are described below.

7.2.1 Geotechnical Data

One IRDMIS geotechnical data file will be generated by the Field Team activities during the work conducted at APG-EA. The Geotechnical Map File (GMA) will contain information about the location of all samples collected as part of the project.

7.2.2 Map File Data

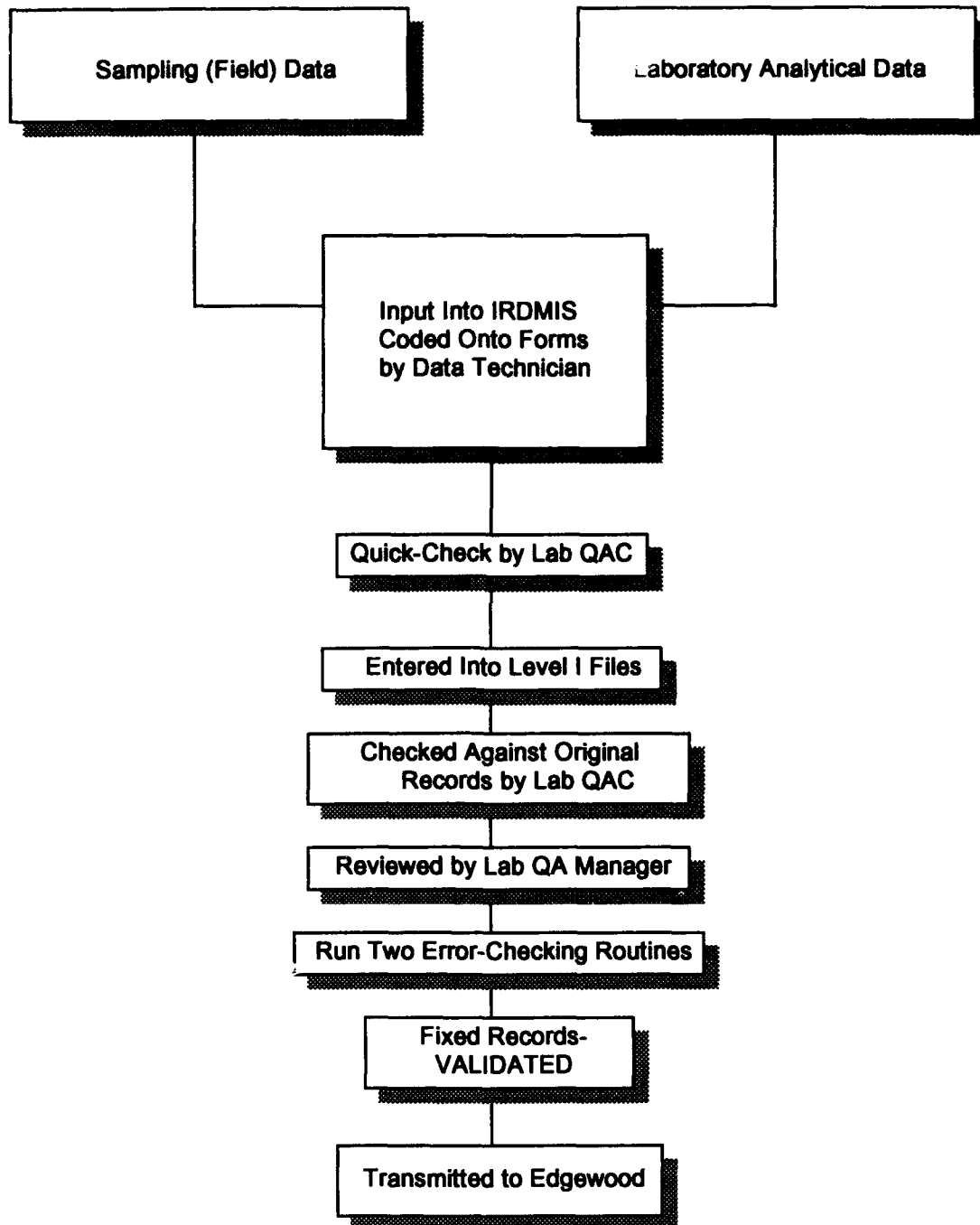
The map file is a listing of sample sites and corresponding north and east coordinates. Map files must be created prior to entry of any other type of sample site data into the IRDMIS. Before sampling is initiated, site coordinates are usually established and entered into the map file. A map file data form will be prepared from data contained in the field sampling logbooks. These data are entered into the computer by the Program Data Coordinator, and a computer printout of the file is checked and corrected by the Task Manager or designee. The data are submitted to USAEC in Level 1 and subsequently validated by the QA Supervisor. Once validated, this map file is elevated to Level 2. This must take place before any other data is processed.



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Figure 7-1 DATA MANAGEMENT SCHEME



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7.3 SAMPLING AND ANALYTICAL DATA

Data from analyses performed by the laboratory are input into various chemical data files, including CGW (groundwater), CSW (surface water), CSE (sediment), CSO (soil data), and CQC (QC data). Data from sampling activities that are required by the laboratory will be submitted by the sampling team on field parameter forms along with the samples. The sampling organization will also be responsible for generation of all map files, as described above. A description of sampling and analytical data generation and manipulation is provided below.

Sampling data will be collected in the field in a permanently bound notebook (log). Portions of the information will be transferred to a three-part field parameter form. This information will include the site type, site ID, sampling date and time, field sample number, sample depth (if applicable), and the sampling technique. This form will accompany the samples to the laboratory so that the information can be encoded prior to sample analysis. A complete list of required information is presented in Table 7-1. In addition, each sample container will be annotated in waterproof ink with the installation name, sample number, sampling date, analytes, and preservatives. A chain-of-custody form will also be completed in the field and will accompany the samples to the laboratory, along with the field parameter form (see Appendix A for sample forms).

Collection of analytical data will begin when samples arrive at the laboratory. A laboratory technician will first verify that the samples noted on the chain-of-custody form coincide with the sample containers being delivered. If any containers are broken or missing, the chain-of-custody form will be annotated and the Task Manager will be notified immediately. Samples will then be logged into a project-specific notebook and the computerized laboratory data management system according to parameter code, site ID, and laboratory sample number. The field parameter and chain-of-custody forms will then be submitted to a laboratory data technician for later correlation with the analytical results.



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Table 7-1 LIST OF SAMPLING DATA

- Installation
- Field Sample Number
- Matrix
- Sampling Depth (if applicable)
- Sampling Date and Time
- Sampling Location
- Method of Sampling
- Analytes
- Preservatives
- Significant Observations
- Printed Name and Signature of Sampler
- Number of Samples Taken
- Temperature, pH, Conductivity, Oxidation/Reduction Potential, and Dissolved Oxygen of Water Sampled
- Number of Shipping Containers
- Date of Shipment



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On receipt of the sample log information, the laboratory Quality Assurance Coordinator (QAC) will assign analytical lot numbers to the samples in accordance with USAEC procedures. The first three letters of the six-character sample code will designate the analytical lot, while the remaining three digits will indicate the sample number within the lot (e.g., AAB006 indicates the sixth sample in lot AAB). All quality control samples required for each analytical lot (e.g., method blank, control spike at two times the certified reporting limit (CRL), and two control spikes at ten times the CRL) will also receive USAEC sample numbers. The data technician will enter the sample information into the IRDMIS to generate partially-completed data coding forms.

When the samples are taken from storage for analysis, the chain-of-custody (COC) form will be signed by the Data Analyst to acknowledge receipt of the samples for processing. When analyses are complete, the Data Analyst will reduce the data for QC samples to determine if the analyses were in control. The QC results will then be reviewed by the Laboratory Section Manager and forwarded to the QAC for verification. If the QAC agrees that the data are in control, the Data Analyst will be directed to proceed with data reduction for the samples. Concentrations of contaminants in extracts will be determined from instrumental responses of the extracts applied to the instrument calibration curve. The resultant concentration will then be modified by applying the appropriate dilution/concentration and sample weight or volume to obtain a final reportable concentration in the original matrix. For soils, results will not be corrected for moisture; however, percent moisture is reported with the analytical results. Aqueous results will be reported in units of micrograms per liter and solid samples will be reported in micrograms per gram.

The data will contain no more than three significant digits and will be rounded to the appropriate number of significant digits, based on certification class and dilution, only after all calculations have been completed. When samples are diluted into a certified range, the reported concentration will contain one less significant digit than an undiluted sample. Values less than the certified reporting limit will be reported as "less than" the CRL. If a sample is diluted below the CRL, the value will be reported as "less than" the CRL.



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multiplied by the dilution factor to more accurately reflect the observable limit. The dilution factor will be reported with the data. Method blank values will not normally be subtracted from sample results submitted to USAEC; however, method blank corrections may be made in accordance with the USAEC QA Program (1990).

When data reduction has been completed for the samples, all data (whether on magnetic media or hard-copy) will be transmitted to USAEC. The correlation of the analytical and field data will be performed by Potomac Research Incorporated (PRI). Table 7-2 lists the information that is required for the IRDMIS. Further data processing is described in the next section.



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Table 7-2 GEOTECHNICAL AND CHEMICAL DATA ENTRY INTO IRDMS

IRDMS DATA ENTRY ELEMENTS	GEOTECHNICAL DATA ENTRY	CHEMICAL DATA ENTRY
Installation	X	X
Laboratory		X
Sample		X
Test Method		X
Measurement Units		X
Analyst		X
Sample Number		X
File Name	X	X
Site Type	X	X
Site ID	X	X
Field Sampler Number	X	X
Sample Date	X	X
Sample Program		X
Sample Depth (cm)	X	
Sample Technique	X	
Lab Analysis Number		X
Sample Preparation Date		X
Analysis Date		X
Test Name		X
Measurement Boolean		X
Uncorrected Measurement Value		X
Dilution Factor		X
Percent Moisture		X
Internal Standard Code		X
QC Test		X
QC Spike Value		X



8.0 SYSTEM CONTROLS

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This section discusses document control, QC samples, control charts, and out-of-control conditions.

8.1 DOCUMENT CONTROL

The goal of the Document Control Program is to ensure that all project documents issued or generated will be accounted for upon completion of the project. SOP 015 summarizes document control procedures.

All documents used or generated during the course of the project are accounted for and become a part of the project files upon completion of the task. These may include but are not limited to the following:

- Sample identification documents and field logbooks;
- Chain-of-custody records;
- Project deliverables (e.g., cluster-specific reports, audit reports);
- Analytical logbooks, laboratory data, calculations, graphs, strip charts, field logs, and software;
- Reports and correspondence material; and
- Photographs, maps, and drawings.

When an error is made on an accountable document, corrections are made by drawing a single line through the error and entering the correct information. The correction must also be initialed and dated. A brief explanation is provided explaining the reason the correction was made.

Controlled documents which are sensitive to timing or approvals will use a document control format in the upper right corner which includes:



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- Document;
- Section number;
- Revision number;
- Date of revision; and
- Page__ of __.

A distribution list of controlled documents will be maintained by the JEG Project Manager (or designee), who will ensure that revisions are distributed to all addressees.

After work on a task has been completed (and while the task is still open) all accountable documents generated or used for the task work will be assembled and located in a secure storage location at JEG's Washington, D.C. office. All accountable task documentation will then be inventoried by the JEG Task Manager. Following the completion of the task, all documentation will be returned to EMO and the APG-EA POC where all documentation will enter final storage for evidentiary purposes.

8.2 LABORATORY QUALITY CONTROL SAMPLES

Laboratory QC samples are prepared and analyzed internally to provide quantitative evidence supporting the performance of the analytical system, and demonstrate that the sensitivity is analogous to the level achieved during certification. The QC samples are prepared by the person conducting the first step of the analytical method. QC samples will be blind to the analyst conducting the actual analysis.

Laboratory quality control samples include the following:

- **Method blank** is a standard matrix sample to which no analyte of interest has been added that is processed in the same manner as samples, to ensure that the apparatus and reagents used are not contributing contaminants to the analysis.



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- **Replicate** is a duplicate sample created in the laboratory that is extracted and analyzed in order to demonstrate the precision of the method of analysis.
- **Surrogate standard** is a pure compound added to every sample to monitor the recovery and to verify the efficiency of the extraction and analysis procedure. Recovery is the percent difference between the concentration spiked and the concentration quantitated by the method.
- **Matrix spike** is a known amount of target analyte added to the sample and which is then carried through the complete analytical method in order to demonstrate the accuracy of the method of analysis.
- **Matrix spike duplicate** is a duplicate of the matrix spike performed in order to demonstrate the precision of the spiking procedure.
- **Laboratory control standard** is a standard that can be traced to an alternate source than the working standard that is analyzed to verify the integrity of the working standard.
- **Homogenization blank** is a rinse blank performed on equipment used to homogenize soil and benthic tissue samples after decontamination procedures have been performed.

The number of laboratory QC samples analyzed is dependent upon the method of analysis. For specific information regarding the number of laboratory QC samples analyzed, please refer to the analytical method.

8.3 CONTROL CHARTS

Where applicable, control charts will be used to monitor the trends and variations in the accuracy and precision of analytical analyses. The control chart shall contain the following:

- Title, analyte, method number, and laboratory name;
- Spike concentration;
- Three-letter lot designation and analysis date for each point along the abscissa;
- Percent recovery (X charts) or Range (R charts) along the ordinate;
- Upper and lower control limits; and
- Upper and lower warning limits.



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Criteria and formats for control chart construction can be found in the USAEC QA Program (1990).

8.4 OUT-OF-CONTROL CONDITIONS

Situations arising from failure to adhere to standard operating procedures, policies, and protocols mandated by the USEPA CLP and USAEC QA program requirements have the potential to adversely affect data quality. All out-of-control situations for all project aspects will be investigated and appropriate corrective actions instituted. Areas in which operator error is normally associated with out-of-control conditions include:

- Failure to achieve calibration;
- Recordkeeping omissions;
- Improper sampling techniques;
- Improper sample storage and preservation; and
- Poor analytical protocols.

The detection of out-of-control conditions warrants some type of corrective action. Section 12.0 of this plan provides protocols for documenting corrective action.



9.0 PREVENTIVE MAINTENANCE

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Instrument maintenance, both routine and preventive, will be performed as required by manufacturer's instructions. A preventive maintenance plan allows for periodic instrumentation checks for problems that occur frequently. The objective of a preventive maintenance plan is to rectify equipment problems before they become serious. Preventive maintenance also brings attention to those areas of the instrument susceptible to degradation from aging, toxic/corrosive attack, and clogging due to environmental factors.

Procedures for preventive maintenance are contained in each instrument's manual under the maintenance/troubleshooting sections. Each piece of equipment will have an associated SOP detailing the calibration/maintenance instructions. Equipment failing calibration specifications will be identified with a red warning label and will not be used for sample analysis until it is returned to its correct operating order.

Equipment requiring calibration will have an assigned record number which is permanently affixed to the instrument. A label will be affixed to each instrument containing the following information:

- Description;
- Manufacturer;
- Model number;
- Serial number;
- Date of last calibration or maintenance;
- Name of person who performed calibration or maintenance; and
- Date of next servicing.

9.1 CALIBRATION/MAINTENANCE FREQUENCY SCHEDULE

Schedules for calibration/maintenance must be accomplished at the manufacturer's recommended frequency, unless prior experience dictates a more frequent schedule.



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Should a schedule not be provided by the manufacturer, the calibration group servicing the equipment must provide a written calibration and maintenance frequency. A list of critical spare parts for field equipment is provided in the respective equipment user's manual.

9.1.1 Field Equipment Calibration/Maintenance Frequency and Calibration Standards

For purposes of preventive maintenance, field equipment in storage will be calibrated by JEG according to the following schedule:

Photoionization Detector:

MICROTIP IS-3000: Every 30 days while in storage and daily before use.

Flame Ionization Detector:

FOXBORO 128: Every 30 days while in storage and daily before use.

Water Quality Analyzer:

YSI 3800

The YSI 3800 water quality system is calibrated in the field. Refer to SOP 043 for calibration of the instrument in the field.

Conductivity, temperature, pH meters, and field soil gas equipment are calibrated only in the field. The particular standards to which the PID and FID are calibrated by the JEG Equipment Manager are specified below:

Photoionization Detector Calibration Standards:

Benzene (C_6H_6) 1010 ppm +/- 1%, balance: Air.

Benzene (C_6H_6) 100 ppm +/- 1%, balance: Air.

Benzene (C_6H_6) 10 ppm +/- 1%, balance: Air.

Isobutylene ($I-C_4H_8$) 100 ppm +/- 2%, balance: Air.

Organic Vapor Analyzer Calibration Standards:

Methane (CH_4) 5 ppm +/- 5%, balance: Air.

Methane (CH_4) 95 ppm +/- 5%, balance: Air.

Methane (CH_4) 950 ppm +/- 2%, balance: Air.



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Analytical accuracy of all calibration gases is traceable to Standard Reference Materials (SRMS) from the National Bureau of Standards (NBS).

9.1.2 Laboratory Calibration/Maintenance Frequency Schedule

The contract laboratory will be responsible for maintaining calibration and maintenance of all laboratory equipment. A list of critical spare parts for laboratory equipment can be found in the Contract Laboratories' Quality Assurance Program Plans and/or SOPs.



10.0 RECORDKEEPING

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Bound logbooks shall be utilized for all recordkeeping purposes both in the field and laboratory. The field logbook SOP can be found in Appendix A (SOP 003 and SOP 016). It is assumed that the use of the bound book will result in a chronological sequence of data insertion. All logbooks will contain a unique document control number. If corporate controlled logbooks are used, the document control number will be on all pages. Non-corporate controlled logbooks will be bound, and the document control number need only be contained on the document cover. All pages will be numbered, but numbered pages may be limited to pages with information.

To facilitate data validation, the person making an entry must sign and date the entry. All entries must be recorded in waterproof ink. Correction to entries shall be made by drawing a line through the incorrect entry, recording the correct information, and initialling and dating the corrected entry.

If computerized information is utilized, a hard copy which has been permanently affixed to the logbook will be acceptable as an original record of sampling and laboratory logging.

Logbooks containing information specific to the project shall be forwarded to EMO at the end of the project. Should the need for corporate controlled logbooks arise, copies of all relevant logbook pages shall be submitted.

10.1 SAMPLING

Logbooks for sampling and field investigation purposes must meet the requirements specified by SOP 003 and SOP 016 (Appendix A). They must be bound, and entries recorded in waterproof ink. The logbook must contain information to distinguish samples from each other. The following information should be included for each sample collected:

- EMO project;
- Field sample number;
- Matrix sampled;
- Sample depth,
- Sampling date and time;



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- Specific sampling location;
- Method of sampling;
- Preservation techniques;
- Filtration method;
- Analytes of interest;
- Volume of water removed during well purging;
- Sampling observations;
- Results of field measurements;
- Printed name and signature of samplers;
- Date of shipment;
- Number of shipping containers, and
- Samples sent and carrier bill of lading number.

10.2 LABORATORY RECORDS

10.2.1 Laboratory Logging

Once samples have been received by the laboratory, they shall be logged into a bound laboratory notebook. Information necessary for the logbook includes:

- Field sample number;
- Laboratory receipt date;
- Condition in which sample arrived;
- Analysis requested; and
- Sample identification number.

10.2.2 IRDMIS Sample Identification Numbers

Data reporting to IRDMIS requires that each aliquot of a sample be assigned a six-character sample identification number. The number is composed of two three character designations. The first three characters define the analytical lot, which is based upon the number of samples capable of being processed in a 24-hour period. The last three characters pertain to the sequential order in which the instrumental analysis will be performed within the lot.



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Different lot designations are used for each analytical method. Multi-analyte methods have the same lot designation for each analyte in a single sample aliquot. Should the contractor laboratory utilize an internal numbering system, the correlation to the Contractor-assigned sample identification number shall be provided in the logbook.

10.2.3 Analytical Records

10.2.3.1 Reference Materials. Bound logbooks must be maintained of all reference materials used for analytical purposes on the project. The record must include the following information:

- Date of receipt;
- Source;
- Purity;
- Composition;
- Storage conditions; and
- Expiration date.

10.2.3.2 Sample Handling. All personnel involved in performing any aspect of the analytical protocol must maintain a record of the activities in a bound logbook. Although this logbook must be specific to the operation, it need not be operator specific. The logbook should be signed and dated daily and contain the following information:

- Samples handled;
- Standards used;
- QC samples prepared;
- Procedures used; and
- Resultant calculations.

10.2.3.3 Instrument Operation. Each instrument must have a dedicated logbook. Information in the logbook must reflect routine and emergency maintenance activities, tuning, absolute and chemical curve calibration, and all analytical activities conducted on



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the instrument. A new page must be started daily during equipment operation. Information to be included for each page consists of:

- Date, operator, and project name;
- Description of any instrument maintenance or modification;
- Tuning and calibration activities;
- Instrument settings;
- Instrument operating conditions; and
- Samples analyzed.

The use of automated data acquisition systems will require recording a reference to the data file for each standard or sample.

Hard copy data output from integrators and chromatograms should have the following information clearly evident on the printout:

- Analysis date and time;
- Test name and sample number;
- Reference to the calibration curve used for quantitation;
- Logbook reference to recorded analytical activities; and
- Identification of chromatographic peaks.



11.0 AUDITS

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This section discusses performance and system audits used to monitor the capability and performance of the total measurement system to evaluate the quality of operation in the field and in the laboratory. A performance audit is a planned independent check of the operation of a system to obtain a quantitative measure of the quality of data generated, and involves the use of standard reference samples or materials which are certified as to their chemical composition of physical characteristics. System audits are of a qualitative nature and consist of on-site review of a system's quality assurance system and physical facilities for sampling/analysis, calibration, and measurement. JEG will be responsible for auditing field activities and the analytical laboratories.

11.1 FIELD SYSTEM AUDITS

A field QA audit will be conducted during the first few days of each field activity (i.e., once for collection of surface water, sediment, surface soil, and sludge, and a second time for groundwater sampling) to determine if the field teams are following protocols delineated in this QAPP. The audit will be performed by JEG's QA Manager or an appropriate designee. The field QA auditor will monitor to determine whether requirements stated in the QAPP are being met. The QA Manager will check for performance of the following items during the course of the audit:

- Copies of the site Health and Safety Plan (HASP) and QAPP are on-site and accessible to the sampling teams;
- The field instruments are of the proper type, and have been properly calibrated, and all calibrations have been recorded in a permanent bound logbook.
- All information listed in the SOP for field logbooks is recorded in a permanent bound log in indelible ink;
- Samples are collected from the least contaminated to the most contaminated locations;
- Sample collection procedures are performed as per the QAPP using the proper sampling equipment, sample containers, and preservatives. Samples are placed on ice immediately after collection;
- Field parameters (pH, temperature, conductivity, dissolved oxygen, oxidation reduction potential, and turbidity) are taken for surface water and groundwater samples. Groundwater samples should not be taken until the field parameters have stabilized according to SOP 013;



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- Surface water sample locations are marked on a site map and photographs (when possible) are taken to describe each location;
- Sample bottles are properly packaged as per the QAPP for shipment (including sealing with appropriate custody seals);
- Chain-of-custody forms include all information listed in the SOP; and,
- Sampling equipment is properly decontaminated between sample locations, as detailed in the QAPP.

During the audit, actions will be taken on the spot by the QA manager to ensure that field sampling is conducted in accordance with the QAPP and the project Work Plan. The QA manager will document any deficiencies encountered during the audit and any actions taken in the field to correct potential problems. If the QA manager has serious concerns about field QA in his initial audit, he may call one or more additional QA audits. Results of the audit will be maintained at the JEG office in Washington, DC as part of the QA documentation.

11.2 LABORATORY SYSTEM AUDITS

The contract laboratory will be evaluated at a frequency dictated by the laboratory's performance, and will include a quality assurance on-site evaluation to inspect the Contractor's facilities to verify the adequacy and maintenance of instrumentation, the continuity of personnel meeting experience or education requirements, and the acceptable performance of analytical and QC procedures. The items to be monitored include, but are not limited to, the following:

- Size and appearance of the facility;
- Quantity, age, availability, scheduled maintenance and performance of instrumentation;
- Availability, appropriateness, and utilization of SOPs;
- Staff qualifications, experience, and personnel training programs;
- Reagents, standards, and sample storage facilities;
- Standard preparation logbooks and raw data;
- Bench sheets and analytical logbook maintenance and review; and
- Review of the laboratory's sample analysis/data package inspection procedures.



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A formal audit report will be provided to the Project Manager, Laboratory Task Manager, and EMO. Results of the audit will be documented and maintained as part of the QA documentation.

11.3 PERFORMANCE AUDIT

EPA Region III may submit a spiked performance evaluation (PE) sample to the sampling team leader. This sample will be submitted to the laboratory with the environmental samples. The sample will be analyzed for any analyses requested by EPA. The results of the analyses will be used by EPA to determine laboratory accuracy.



12.0 CORRECTIVE ACTION

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Corrective action will be initiated through the development and implementation of routine internal quality control checks. Specific limits beyond which corrective action is required will be established for each system. Corrective action requirements will be implemented in response to deficiencies encountered during system audits.

To enhance the timeliness of corrective action and thereby reduce the generation of unacceptable measurement data, problems identified by assessment procedures will be resolved at the lowest possible management level. Problems that cannot be resolved at this level will be reported to the QA Manager for resolution. The QA Manager will determine at which management level the problem can best be resolved, and will notify the appropriate manager. Weekly progress reports will detail all problems and subsequent resolutions.

Steps comprising a closed-loop corrective action system include:

- Defining the problem;
- Assigning responsibility for problem investigation;
- Investigating and determining the cause of the problem;
- Assigning responsibility for problem resolution; and
- Verifying that the resolution has corrected the problem.

Documentation on the corrective action requirements, the assignment of responsibility for corrective action, due dates for completion of corrective action, and validation of completion will be maintained. Such documentation will be reviewed during system audits. Figure 12-1 is a proposed report form for use by all project staff to document the resolution of all corrective actions.

12.1 LINE OF COMMUNICATION FOR CORRECTIVE ACTION



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If a visitor to the site, including USEPA and State of Maryland oversight personnel, observes a health and safety or quality assurance problem at the site, or a deviation from the work plan, the visitor should express their concern to the JEG Field Operations Leader or Task Manager. The JEG personnel will either agree with the visitor, correct the perceived problem or deviation, and continue working, or will disagree with the visitor and continue working. The visitor's comments will be documented in the appropriate field logbook. If the visitor's comment is not acted upon by the JEG Field Operations Leader or Task Manager, the visitor may communicate with the facility environmental coordinator, who may decide to contact the APG Project Officer. It should be noted that the JEG Field Operations Leader and Task Manager will comply with directions given by the APG Project Officer but not necessarily with visitors to the site or regulatory oversight personnel.



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Figure 12-1 CORRECTIVE ACTION REPORT FORM

Date of Problem: _____ Originator: _____

Description of Problem and Effect on System: _____

Persons Notified:

Title:

Date:

Description of "Corrective Action": _____

Prepared By: _____
Signature

Date

Field Operations Manager Review: _____
Signature

Date

Project Manager Review: _____
Signature

Date

QA Manager Review: _____
Signature

Date



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13.0 QUALITY CONTROL REPORTS

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The following documents and deliverables will be submitted to EMO in support of the project work performed at APG.

- Pre-certification and certification data packages;
- Audit reports;
- Weekly QA/QC reports during field activities;
- IRDMIS submissions;
- Monthly status reports of QC activities;
- QC charts (during periods of analytical analyses);
- Logbooks;
- QA section of the project final report; and
- Project final report

EMO will be responsible for the final storage and security of all data files at a location on APG.

If changes are to be made to this QAPP prior to the close of the project, the proposed changes will be submitted to EMO.



14.0 REFERENCES

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APPENDIX A
STANDARD OPERATING PROCEDURES

The Standard Operating Procedures (SOPs) are included in a separate document.

APPENDIX B. JEG PERSONNEL QUALIFICATIONS
(To be added when task is initiated)

APPENDIX C. METHODOLOGIES

TO BE INCLUDED WHEN A LABORATORY IS SELECTED

APPENDIX D. LABORATORY STATEMENT OF QUALIFICATIONS AND QA PROGRAM

TO BE INCLUDED WHEN A LABORATORY IS SELECTED